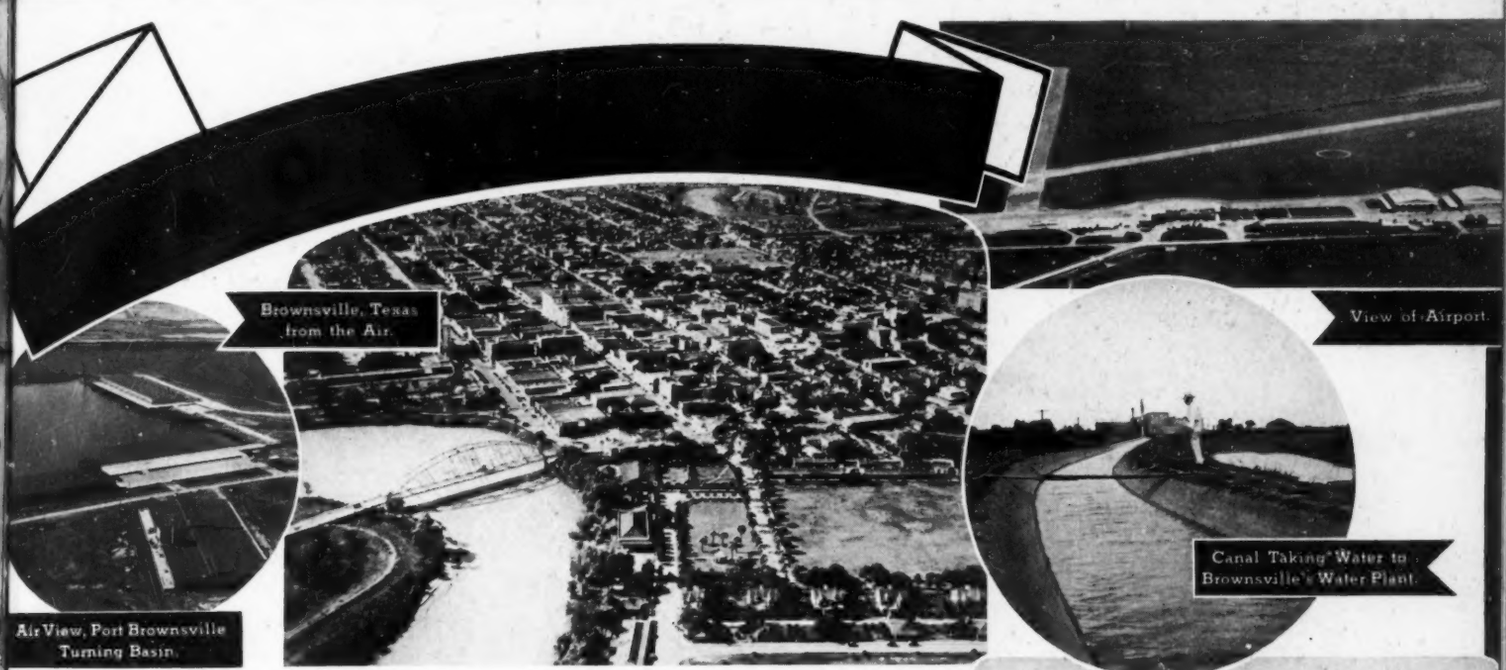
WATER WORKS & SEWERAGE

A GILLETTE ABP ABC PUBLICATION

L. H. Enslow
EDITOR

OCTOBER 1938
VOLUME 85, No. 10



Brownsville, Texas from the Air.

View of Airport.

Air View, Port Brownsville Turning Basin.

Canal Taking Water to Brownsville's Water Plant.

Located at the southern tip of Texas on the Rio Grande River, twenty-five miles from the Gulf of Mexico, Brownsville, Texas is the largest city in the rich Lower Rio Grande Valley.

From this rich valley comes the entire supply of Texas' grapefruit and oranges and much of its winter vegetables. However, citrus production is but one of Brownsville's trades—canning plants, bulk oil stations and a number of factories making palm leaf hats, farm children's dresses, men's work clothes and novelties ship their products over a wide area.

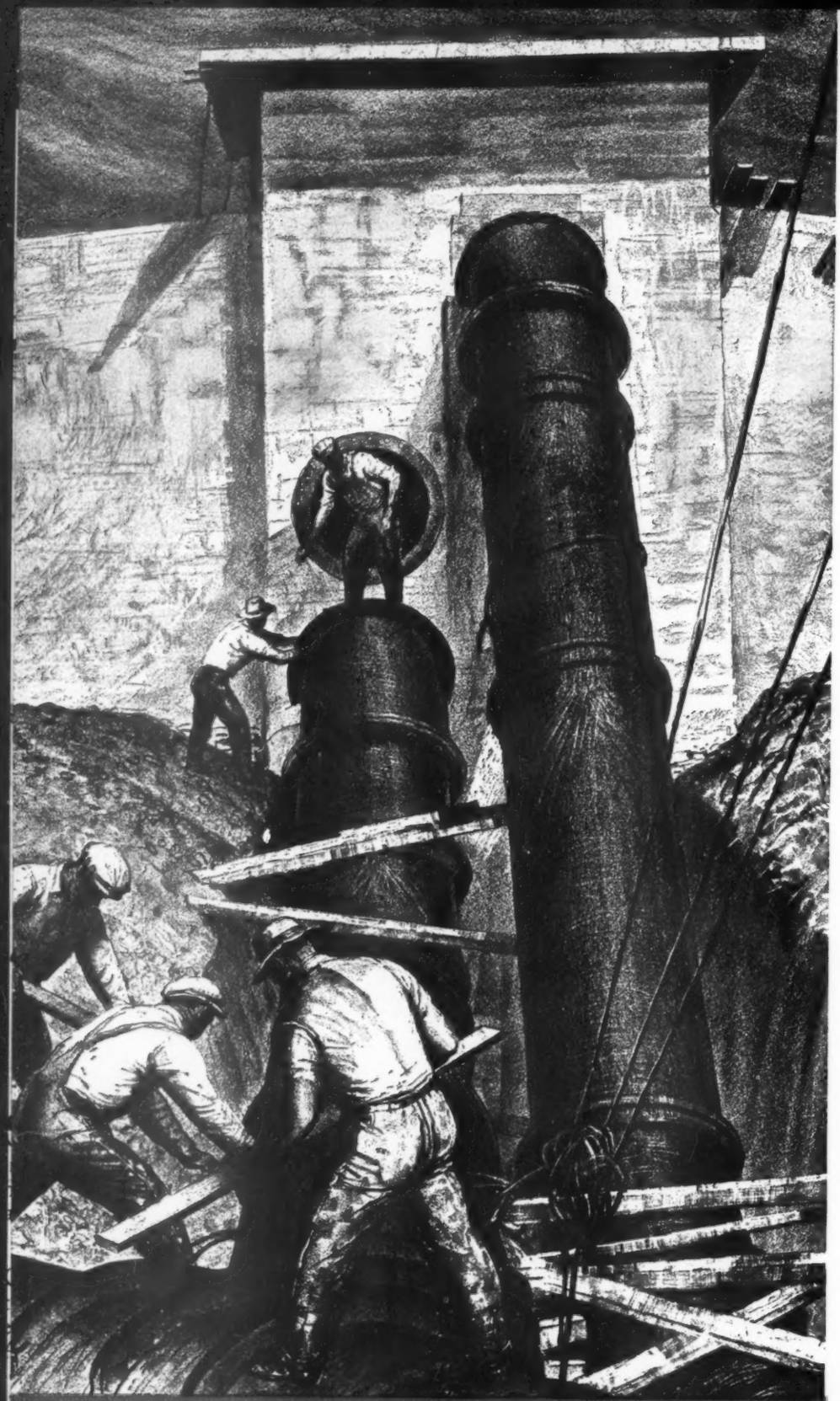
As a key point in the transportation scheme between the Americas, Brownsville is a railway port of entry, has a fine network of paved roads and is the northern terminus of Pan American Airways Western Division. Its transportation picture was completed when the Port of Brownsville was opened, making the city a seaport. This man-made channel, 17 miles long, terminates in a mammoth turning basin that makes a perfect land-locked harbor.

We are justly proud of the fact that Pittsburgh Water Meters are found accurately measuring Brownsville's water supply. Water is pumped from the Rio Grande River to a 7 million gallon raw water reservoir, then filtered and treated in a modern filtration plant before it is supplied to the citizens.

Filtration Plant.

PITTSBURGH EQUITABLE METER CO.
MERCO NORDSTROM VALVE CO.
Main Offices - PITTSBURGH, PA.
NEW YORK BUFFALO PHILADELPHIA DES MOINES CHICAGO COLUMBIA
KANSAS CITY TULSA LOS ANGELES MEMPHIS OAKLAND HOUSTON

PITTSBURGH WATER METERS



Photographed on stone by James E. Allen for U. S. Pipe & Foundry Co. Copyright 1938, U. S. Pipe & Foundry Co.

SUPER-DE LAVAUD CENTRIFUGAL CAST IRON PIPE

U. S. Pit Cast Pipe — U. S. Mechanical Joint Pipe
U. S. Threaded Cast Iron Pipe
U. S. Ni-Resist Cast Iron Pipe
U. S. Flexible Joint Pipe — U. S. Cast Iron Culverts
Alloy and Gray Iron Castings
U. S. Cast Iron Roof Plates

Cast Iron Pipe, centrifugally or pit cast, for water works, gas, sewerage, drainage and industrial service.

U. S. PIPE & FOUNDRY CO.
BURLINGTON, NEW JERSEY
Foundries and Sales Offices throughout the U. S.

◆

ADVANTAGES enjoyed by purchasers of U. S. Pipe are the *plus-services* made possible by strategically-located plants and storage yards; by complete and modern laboratory facilities; and by an expert technical staff. Co-operation in pipe design for unusual requirements, and strict adherence to exacting delivery schedules, can be counted on. We are organized and equipped to render a complete service in long-lived Cast Iron Pipe, either pit or centrifugally cast, for delivery anywhere to American and export customers.

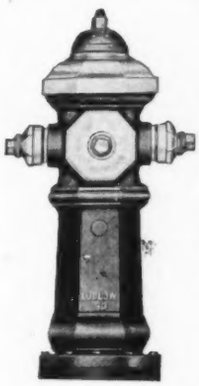
◆

U.S. cast iron PIPE

LUDLOW EQUIPMENT
for the *EXACTING*

Every Ludlow product is made of carefully selected materials and built to the highest standards. It is thoroughly inspected before release and is guaranteed against defects. This protects you—and guards the Ludlow reputation for dependability and accuracy.

Ludlow engineering service is always available to everyone in the water works and sewerage field. Its engineers welcome your problems and requests for information and estimates.

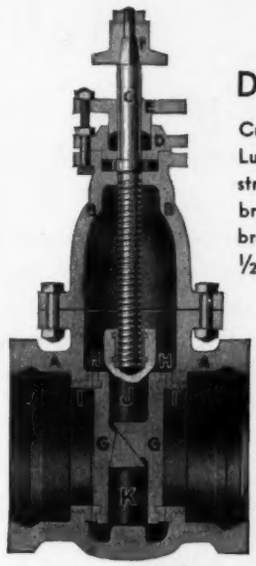


LUDLOW FIRE HYDRANTS

Improved and simplified for instant service at all times and in any weather. Designed to break off only above ground, making repairs and replacements easy. They are quickly adjusted, do not freeze up and require very little attention.

IMPROVED SLUICE GATE WITH HYDRAULIC CYLINDER

Distinctly new type gate with top, side and bottom adjustable wedges for unseating pressure. Rising and non-rising types, round or square openings, with varied operating controls.



DOUBLE GATE VALVES

Cutaway view shows simplicity of typical Ludlow gate valve and double disk construction. In 22 sizes—steel, iron, and bronze mounted—4" to 80". Also in bronze, 3/8" to 12"; and extra heavy bronze 1/2" to 2". Fully described in catalog.

HYDRAULIC OPERATED VALVES

Ludlow hydraulic cylinders, for valves of any size and for any pressure, are standard in hundreds of plants throughout the country.

SHEAR GATES

In all-iron or with bronze mountings. Spigot end type regularly stocked.

MUD VALVES

with bronze stems, seats and gate rings. In extension stem and wheel or floor stand types. Sizes 4" to 24".

FLAP VALVES

Furnished in all-iron or iron body with bronze mountings. Sizes 3" to 48". Flange, spigot or bell ends.

BRANCH OFFICES:

NEW YORK	11 WEST 42ND ST.	KANSAS CITY	R. A. LONG BLDG.
BOSTON	73 TREMONT ST.	PHILADELPHIA	HARRISON BLDG.
CHICAGO	7 SO. DEARBORN	PITTSBURGH	OLIVER BLDG.

MAIN OFFICE AND FACTORY

The LUDLOW VALVE MFG. CO.
TROY · NEW YORK

WATER WORKS AND SEWERAGE, October, 1938. Volume 85. Number 10. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States and Canada, $2.00 per year; Foreign, $3.00 per year. Copyright, 1938. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

"Taffy" TROUBLE

. . . is practically ended when you use liquid chlorine free from *hexachloroethane*

A single glance at that persistent, sticky gum known as "taffy," and it is easy to see what it does to a chlorinator. No accurate mechanism could continue to function properly with such a substance clogging up its parts.

Determined to clean up the Liquid Chlorine supplied to water works users, this Company has found that the most persistent trouble-maker is *hexachloroethane*. Remove that, and you've ended most "taffy" troubles originating from Liquid Chlorine quality.*

We have done just that. You can depend on this Liquid Chlorine to cut down chlorinator irregularities. This pure product is promptly available in any desired quantity. We will gladly quote on your requirements.

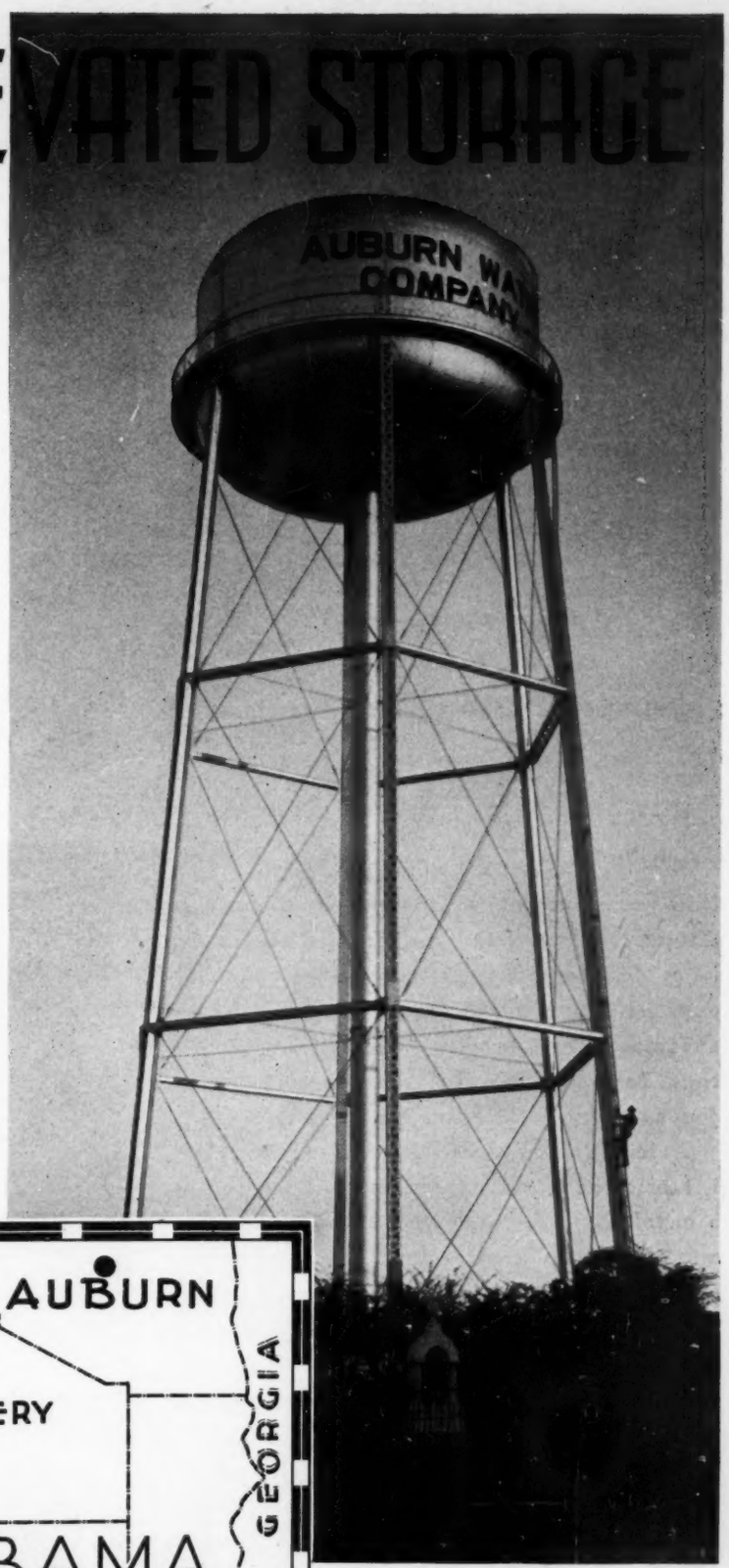
Liquid Chlorine

PENNSYLVANIA SALT MANUFACTURING COMPANY · Est. 1850
WIDENER BLDG., PHILADELPHIA, PA.
New York · Chicago · St. Louis · Pittsburgh · Tacoma · Wyandotte
PERCHLORON · CHLORINE · AMMONIA · FERRIC CHLORIDE · FILTER ALUM

PENNSYLVANIA SALT *Chemicals*

*"Taffy" in a chlorinator frequently is due to other things, such as over-lubrication of chlorinator parts in contact with chlorine, failure of oil chamber pressure gauge diaphragm, moisture entering chlorine chambers during shutdowns or changeovers, etc.

Efficient ELEVATED STORAGE for *Auburn, Alabama*



A 200,000-GAL. Horton ellipsoidal bottom tank has recently been installed by the Auburn Water Company to serve the city of Auburn, Alabama. The water company has long recognized the advantages of elevated storage for, prior to the installation of the new tank, it relied upon a 125,000-gal. tank to give desired pressure in this progressive Southern city. In order to provide for the present demand, which averages 67 gallons per day per capita, and to be assured of an adequate supply for years to come, the new 200,000-gal. tank was installed.

Our nearest office will be glad to supply waterworks engineers and municipal officials with information regarding the experience of other cities with elevated storage or cost data for estimating purposes.

The photograph at the right shows the 200,000-gallon Horton tank that provides gravity pressure in the waterworks system at Auburn, Ala. The map shows the general location of Auburn with respect to surrounding cities.

CHICAGO BRIDGE & IRON COMPANY

Chicago .....2198 Old Colony Bldg.	Birmingham.....1586 North 50th Street	Philadelphia.....1644-1700 Walnut St. Bldg.
New York.....3390-165 Broadway Bldg.	Tulsa.....1646 Hunt Bldg.	Boston.....1548 Consolidated Gas Bldg.
Cleveland.....2262 Rockefeller Bldg.	Houston.....2919 Main Street	San Francisco.....1083 Rialto Bldg.
Dallas.....1479 Liberty Bank Bldg.	Detroit .....1551 Lafayette Bldg.	Los Angeles.....1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

FOR LONG TROUBLE-FREE SERVICE

Specify Armco Sewer Pipe

—Because It Eliminates Structural Failures; Reduces Infiltration; Prevents Stoppage by Tree Roots

Now you can design an economical sewer that is virtually uncrushable; a sewer that will retain its grade, alignment and watertightness without expensive bedding or cradle supports. These advantages are assured in Armco Sewer Pipe because its strength, flexibility and tightly coupled joints are proved by 40 years of experience.

To insure long material life, Armco Sewer Pipe is fabricated of galvanized ARMCO Ingot Iron — a metal used successfully in sanitary sewers for more than a quarter-century. Then too, Armco pipe is paved in the bottom and heavily coated with a special bituminous material bonded to the pipe by asbestos fibres. This affords lasting protection against forces that sometimes destroy other sewer materials.

You'll find many other practical advantages of Armco Sewer Pipe in our 48-page sewer book. Write today for a free copy. Armco Culvert Manufacturers Association, Middletown, Ohio.

Several miles of Armco sewer pipe and fittings were used for this large combined sewer installation in an eastern state.

ARMCO

Asbestos Bonded
ARMCO SEWER PIPE

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

Don't pay Heavy Valve Premium on 100-pound Systems

INSTALL CRANE LIGHT STANDARD IRON BODY VALVES

Crane No. 777 Light Standard Iron Body Double Disc Gate Valve with hub ends and non-rising stem. Brass trimmed.

IT'S WHAT'S INSIDE THAT COUNTS!

● If your operating pressure on the water mains does not exceed 100 pounds, it will pay you to look into the Crane No. 777 Light Standard Iron Body Double Disc Waterworks Gate Valves.

Here is a medium-weight valve that has all the needed features of the heavier patterns designed for municipal systems—that gives you the efficiency and durability of a heavier valve, but saves the premium required on heavy valves with pressure ratings in excess of the needs of your system.

It's Crane inside quality in the No. 777's—as in all Crane Valves—that is your assurance of dependable and lasting performance. It's the soundness of Crane engineering through and through, Crane's skill in metallurgy, and a manufacturing experience of more than 80 years that account for better valve behavior wherever Crane valves are installed.

Start an economy program on your valve needs today. Turn to page 107 of your Crane No. 52 Catalog for complete details on Crane No. 777 Light Standard Iron Body Gate Valves. The line is complete—it fills every need of water works, filtration plants, and sewage disposal systems operating at pressures up to 100 pounds.

CRANE

VALVES • FITTINGS • PIPE • PLUMBING • HEATING • PUMPS

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO, ILL.

NATION-WIDE SERVICE THROUGH 134 BRANCHES AND MORE THAN 500 WHOLESALERS

You can't tell by the looks of a frog how far he can jump . . .

Don't guess at performance. Measure it!

No one can select activated carbons by sight, by weight, or by other quick observation. Carbons are not alike in their capacity to remove tastes and odors from your water supply. You can, however, select the best carbon for your needs by subjecting the different carbons to a performance test on the water you have to treat.

The Threshold Odor test provides reliable and impartial means for making this performance comparison.

Put Hydrodarco to the test. Convince yourself that with this modern activated carbon specially made for water treatment, you get maximum odor reduction with minimum carbon dosage.

Write for liberal sample of Hydrodarco and a Darcograph set with detailed instructions.

DARCO

DARCO CORPORATION

60 East 42nd Street, New York, N. Y.

Distributing Points

•

NEW YORK - - BUFFALO
CINCINNATI - - CHICAGO
ST. LOUIS - NEW ORLEANS
KANSAS CITY - - - SAN FRANCISCO - LOS ANGELES
• MARSHALL, TEXAS •
• MONTREAL, CANADA •

the START of SEWER-LINE SAVINGS - - -

From installation throughout years of service, Transite Sewer Pipe brings lower costs and increased efficiency

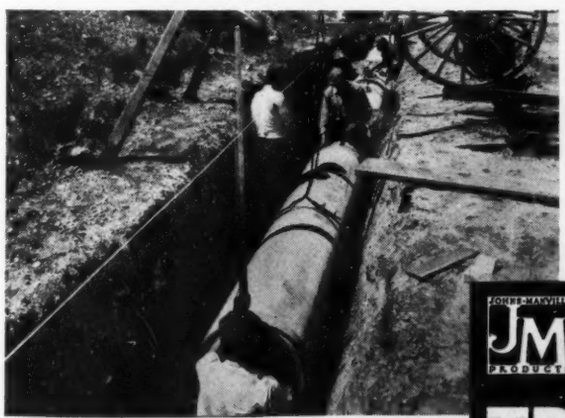
WHAT are the reasons for Transite Sewer Pipe's efficient, economical service?

To begin with, this asbestos-cement pipe has an unusually low resistance to flow because of its smooth interior surface—Williams & Hazen's C=140, or comparable Kutter's n as low as .009 for average slopes. Therefore, sewage flows more readily. Pipe may be laid to flatter grades, in shallower, less expensive trenches. Or advantage may be taken of Transite's high delivery capacity by using smaller pipe.

The sleeve-type joints used in Transite lines are unusually tight. Thus, infiltration is minimized, greatly reducing the amount of ground water that enters the system and effecting substantial savings at the treatment plant. Furthermore, because of Transite's long 13-foot lengths, there are fewer joints to be poured . . . installation is speeded up . . . costs are reduced.

In addition, Transite Sewer Pipe is strong and durable; its relatively light weight facilitates handling, reduces trucking costs. And its asbestos-cement composition, being highly resistant to all forms of corrosion, virtually eliminates maintenance expense.

Before you start your next sewer line, you will want all the facts on this modern sewer pipe. For complete details, write for the new Transite Sewer Pipe brochure. Address Johns-Manville, 22 East 40th Street, New York, N. Y.



EASILY INSTALLED. Transite's long 13-foot lengths and light weight cut installation costs to a minimum. Pipe is more easily laid to accurate grades, and, because there are fewer joints to be poured, assembly is rapid and economical.

SEND FOR THIS FREE BOOK...

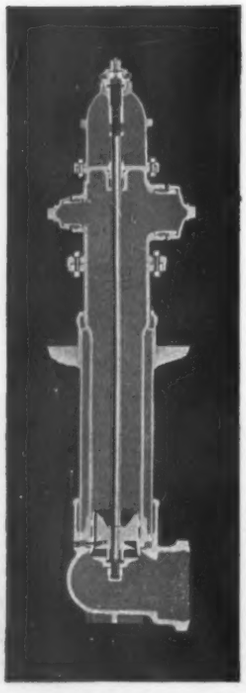
This new brochure contains complete details on the many advantages of J-M Transite Sewer Pipe. It describes new ways to cut sewer-line costs and improve the efficiency of your system.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE SEWER PIPE

AN ASBESTOS PRODUCT

YOU DIG ONLY ONCE
When You Buy Mathews Hydrants



● Install a Mathews Hydrant and you can forget about breaking pavements or digging in the future. Like spark plugs, Mathews barrels are interchangeable. The whole barrel, including all working parts, can be unscrewed, lifted out through the protection case, and replaced from above ground in less than 15 minutes.

Accidents which break the barrel never seriously interrupt Mathews service. The broken barrel can be replaced quickly and economically without digging.

Change of street grade reveals another economy to the Mathews user. The protection case can be cut off or added to, and a barrel of the proper length inserted—without digging.

Modernization is a simple matter. New Mathews barrels with steamer nozzles, revolving heads, and shield operating nuts can be installed practically for the cost of materials—without digging. . . . Specify Mathews.

MATHEWS HYDRANTS

Made by R. D. WOOD COMPANY

Manufacturers of Sand Spun Pipe (centrifugally cast in sand molds) and R. D. Wood heavy-duty gate valves for water works

400 CHESTNUT STREET, PHILADELPHIA, PA.

● Experience counts—and counts heavily—in producing and servicing such an important product as liquid chlorine. That's why EBG, America's pioneer producer, is favored by many of the country's most exacting users. They know that EBG has the experience to handle all problems and meet all requirements wherever liquid chlorine is used. You hear it often—"They know their stuff at EBG!"

ELECTRO BLEACHING GAS COMPANY

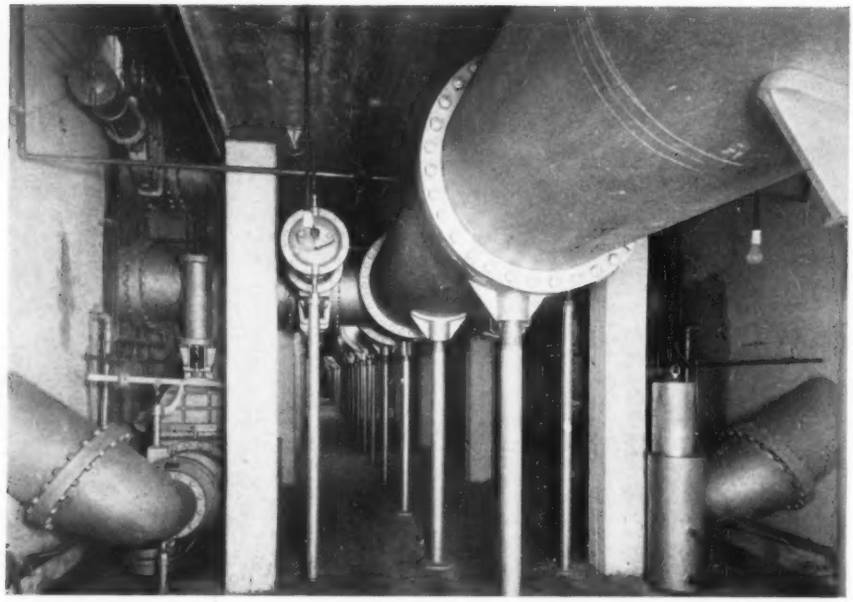
MAIN OFFICE: 60 EAST 42nd STREET, NEW YORK, N. Y. • PLANT: NIAGARA FALLS, N. Y.

EBG Liquid Chlorine

FIRST IN THE COUNTRY

SYNONYMS for SIMPLEX

Accuracy
Sensitivity
Satisfaction



Denver, Colorado — Alvord, Burdick & Howson, Cons. Engrs.

SYNONYMS for SIMPLEX — Accuracy — Sensitivity — Satisfaction — Flexibility — Sturdiness of Construction.

Simplex Controllers, Gauges, Venturi Type Meters, Sand Expansion Indicators satisfy the most rigid requirements of operating and designing engineers.

LET SIMPLEX ENGINEERS AID IN SOLVING YOUR PROBLEMS - WRITE FOR DATA

SIMPLEX VALVE & METER CO.
6743 UPLAND STREET • PHILADELPHIA, PA.

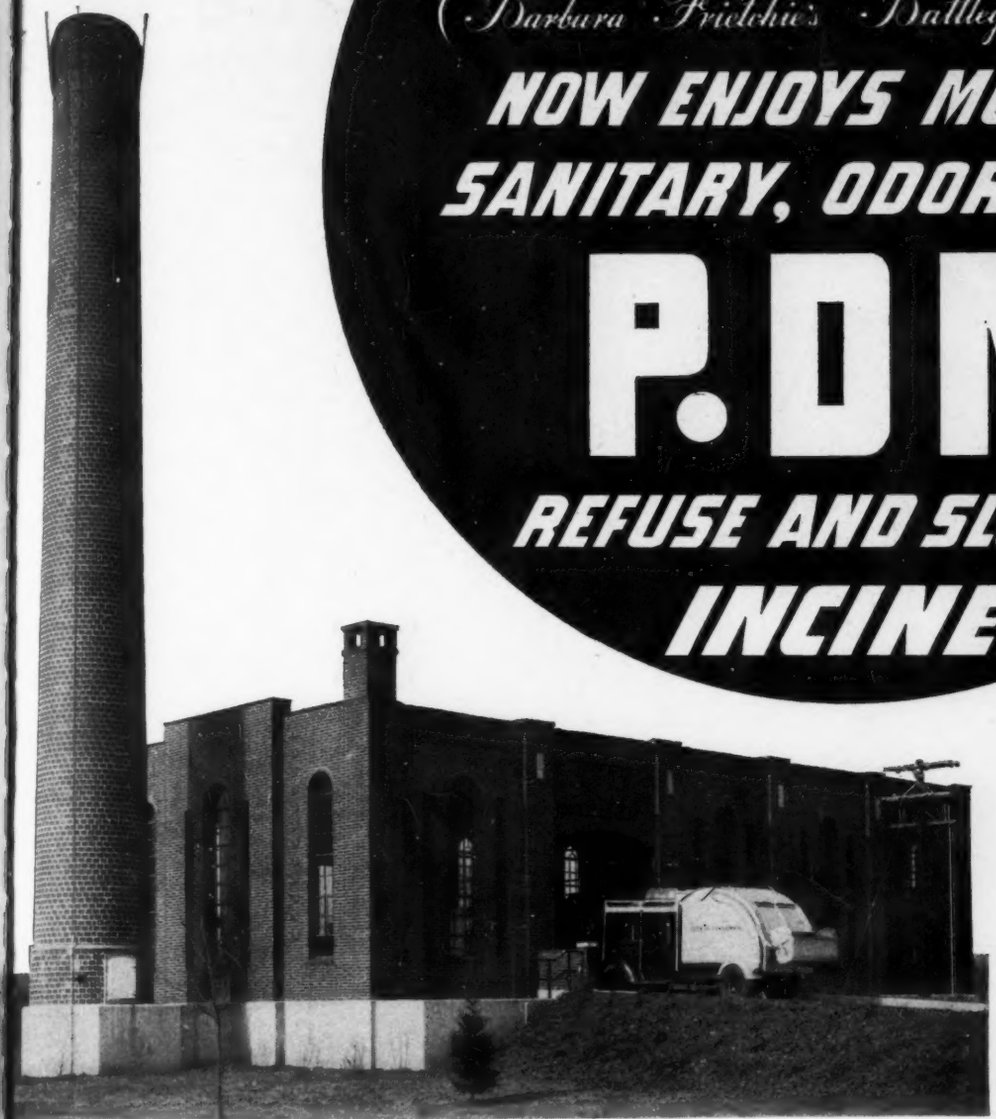
FREDERICK, MARYLAND

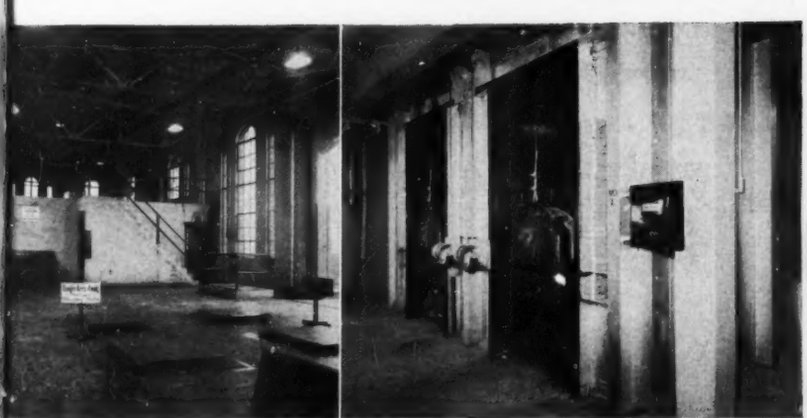
(Barbara Frietchie's Battleground)

NOW ENJOYS MODERN SANITARY, ODORLESS

P·DM

REFUSE AND SLUDGE INCINERATION





P·DM ALWAYS ON THE JOB

"The clustered spires of Frederick stand Green-walled by the hills of Maryland..." So sang the poet Whittier of the pretty, spotless little town where Barbara Frietchie encountered a gallant Southerner these many years ago.

Still charming, still spotless is the thriving modern City of Frederick, well-guided by progressive government. Helping to guard the health and attractive surroundings of Frederick's citizens is this new Sewage Disposal-Incinerator Plant in which a PITTSBURGH-DES MOINES HIGH TEMPERATURE REFUSE INCINERATOR destroys all garbage and rubbish collected by the City together with sludge from the sewage disposal plant.

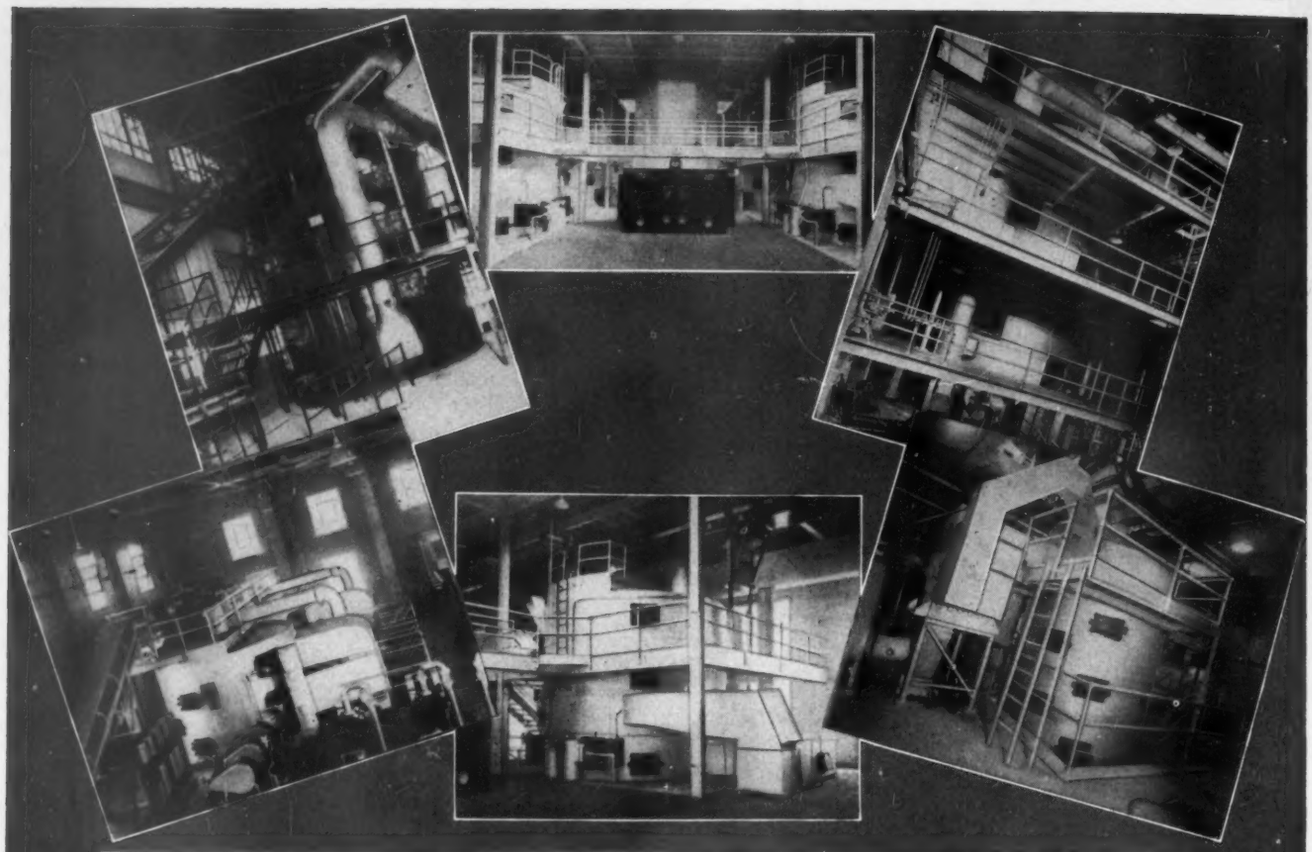
Let us show you how P·DM Incineration can benefit *your* municipality —at your convenience, without obligation!

PITTSBURGH · DES MOINES STEEL CO.

PITTSBURGH, PA. 3418 NEVILLE ISLAND — DES MOINES, IA. 919 TUTTLE ST.

NEW YORK, ROOM 918-99 270 BROADWAY CHICAGO, 1-22 FIRST NATIONAL BANK BUILDING
DALLAS 1223 PRAETORIAN BUILDING SAN FRANCISCO 625 RIALTO BUILDING

27 HERRESHOFF SLUDGE FURNACES



—IN 18 CITIES—

The eighteen cities that have selected Nichols Herreshoff incinerators may truly designate their sewage works as *disposal* plants. Incineration provides positive sanitary disposal regardless of plant location or climate.

Nichols Herreshoff furnaces have 50 years of industrial operation back of their design and operation. They are simple and economical to operate and provide the utmost in plant flexibility.

The experience of this organization is offered, without obligation, to engineers interested in providing modern and simple equipment for sludge incineration.

NICHOLS

ENGINEERING & NERCO RESEARCH CORP.

60 WALL TOWER NEW YORK, N. Y.

WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher — L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"The New Filter Plant of St. Louis County" is to be described in an article by W. V. WEIR, Superintendent of St. Louis County Water Co. Mr. Weir's pictures prove that a modern filtration plant can be built attractive in appearance without any considerable added cost. His article reveals several innovations in plant design and equipment, productive of efficiency and economy of operation. Looking to operating simplification and economy, St. Louis County's 36 m.g.d. plant is so designed as to be operated by one operator on each eight hour shift. Based on the operating results cited, the author states with justification—"Needless to say, we are as proud of the appearance of the plant as we are of the results in operation."

"Metering Experiences" comes from the live-wire Superintendent of the Water Bureau of Cicero, Ill., FRANK J. BROZ. In seeking to reduce unaccounted for water, Mr. Broz found much could be accomplished through improved meterization. How and what he did and the results attained are enlightening and interesting. At the expense of letting the cat part way out of the bag, we will tell you that Mr. Broz has been a "Battery Meter Man" ever since he checked into what's what in meter performance. Result—choice of the meter for a job and not a meter to do a job. This experience has led to many innovations in metering practice, and also to complete modernization of Cicero's meter-shop.

"Degreasing Sewage" constitutes an account of accomplishments at the sewage treatment plants of Lancaster, Pa. GORDON J. WIEST, Plant Chemist at Lancaster, tells of experiences with the combination scheme of 4 minute preaeration, assisted by chlorination, in removing greases from the sewage ahead of the activated sludge aeration units. The results have been extremely significant on this large scale operation. In fact, comments the author, "since introducing the 'aero-chlorination' process Lancaster has experienced its first 6 months of continuously successful operation of the activated sludge process." The explanation seems to lie in the markedly reduced grease accumulations on the activated sludge floc particles, resulting in sludge bulking elimination — seemingly a more efficient sludge.

"A Scheme for Promptly Revealing Main Break Locations" is described by ALFRED F. THEARD, General Superintendent and Engineer, Sewerage and Water Board of New Orleans. In New Orleans, four main arteries leave the pumping station to feed the distribution system, at as many separate points. A scheme has been devised for promptly revealing a main-break or blown joint on any of these important feeder arteries. Involved is the adaptation of pitometer tube installations, connecting to instruments in the central station. In case of a break, check valves located on the pumping mains near the junction of pumping artery and distribution grid reduce water loss, property damage and pressure drop to a minimum. The scheme has well proven its value.

"An Interesting Report of the California Sewage Works Ass'n" from Associate Editor A. M. RAWN (Los Angeles), which unfortunately could not be run in this issue will appear in November.

Vol. 85, No. 10

CONTENTS for OCTOBER, 1938

Filter Innards—Minus Coli, Aerogenes and Headaches 941
By H. S. TURNER
Research Engineer, The Anthracite Institute, Inc., State College, Pa.

Report of New England Water Works Association Convention 948

Filter Bed Agitation With a "Filter Sweep" 956
By C. E. PALMER
Engineer, Water Department, Erie, Pa.

Meeting of Virginia Section A. W. W. A. 959

Design and Operation of Topeka Activated Sludge Plant 971
By T. R. HASELTINE
Superintendent Sewage Works, Butler, Pa.

A Water Tower A-Fire 978
By F. J. RENY
General Manager, Portland Water District, Portland, Me.

Reduction of Bacteria in Sewage by Chlorination 983
By G. E. SYMONS, R. W. SIMPSON and WM. L. TORREY
Chief Chemist, Assoc. San. Chemist, Asst. San. Chemist,
Buffalo Sewer Authority, Bird Island Laboratory

Venturi Metering Equipment in Modern Sewage Works 990
By ROBERT T. REGESTER
Whitman, Requardt and Smith, Engineers, Baltimore, Md.

Editorial: John R. Baylis, Dexter Brackett Medalist 993

Equipment News 994

With the Manufacturers 997

Meetings Scheduled 998

Catalogs and Literature Received 998

Published monthly by the GILLETTE PUBLISHING CO., 330 South Wells Street, Chicago, Ill.

Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3,1879. Published monthly at 330 S. Wells Street, Chicago, Ill. Per Copy, 25c Subscription rates, United States and Canada, $2.00 per year; Foreign, $3.00 per year.

Copyright, 1938, by Gillette Publishing Company, Publishers of: Water Works and Sewerage, Roads and Streets, Sporting Goods Journal, Mida's Criterion, Oil and Soap, Powers' Road and Street Catalog and Data Book.

HALBERT P. GILLETTE, Pres. and Editor-in-Chief; E. S. GILLETTE, Vice Pres. and Publisher; L. H. ENSLOW, 155 East 44th Street, New York, N. Y., Vice Pres. and Editor; C. T. MURRAY, Managing Editor; J. R. BAYLIS, Associate Editor; A. M. RAWN, Associate Editor; H. A. FABER, Associate Editor; J. M. ANGELL, JR., Eastern Manager; T. F. KILROE, New England Representative; D. G. LEDGERWOOD, Advertising Editor.

Chicago Office, 330 S. Wells Street. Cleveland Office, 1601 Lauderdale Avenue. Lakewood, Ohio. New York Office, 155 East 44th Street. San Francisco Office, 155 Montgomery Street. Los Angeles Office, 318 W. Ninth Street.

Addresses will be changed as frequently as desired, upon notification: not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Water Works and Sewerage*, in order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.

It's there—even tho' you don't see it!

THE SYMBOL OF SUSTAINED ACCURACY

—like Trident Meter Quality

The human eye never sees and the camera rarely catches multiple flashes of lightning actually blown together in a high wind! **Neither may you be able to perceive the multiplicity of fine points about today's Trident Water Meters—built by modern precision shop-equipment to standards of precision, closer tolerances and finer finish that only our "super-gauges" reveal. Gone with the wind are yesterday's standards of precision in Trident Meter production . . . today these meters make possible higher percentages and closer range of accuracy, perfect interchangeability, longer life, lower maintenance costs . . . striking proof of the value of Neptune pioneering in precision methods of water meter manufacture.**

FROST PROOF

SPLIT CASE

Trident

PRECISION-BUILT

WATER METERS

NEPTUNE METER CO., 50 W. 50th ST. (Rockefeller Center), NEW YORK CITY
NEPTUNE METERS, LTD., 345 SORAUREN AVENUE, TORONTO, CANADA

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 85 OCTOBER, 1938 No. 10

FILTER INNARDS

Minus Coli-Aerogenes and Headaches

By H. S. TURNER

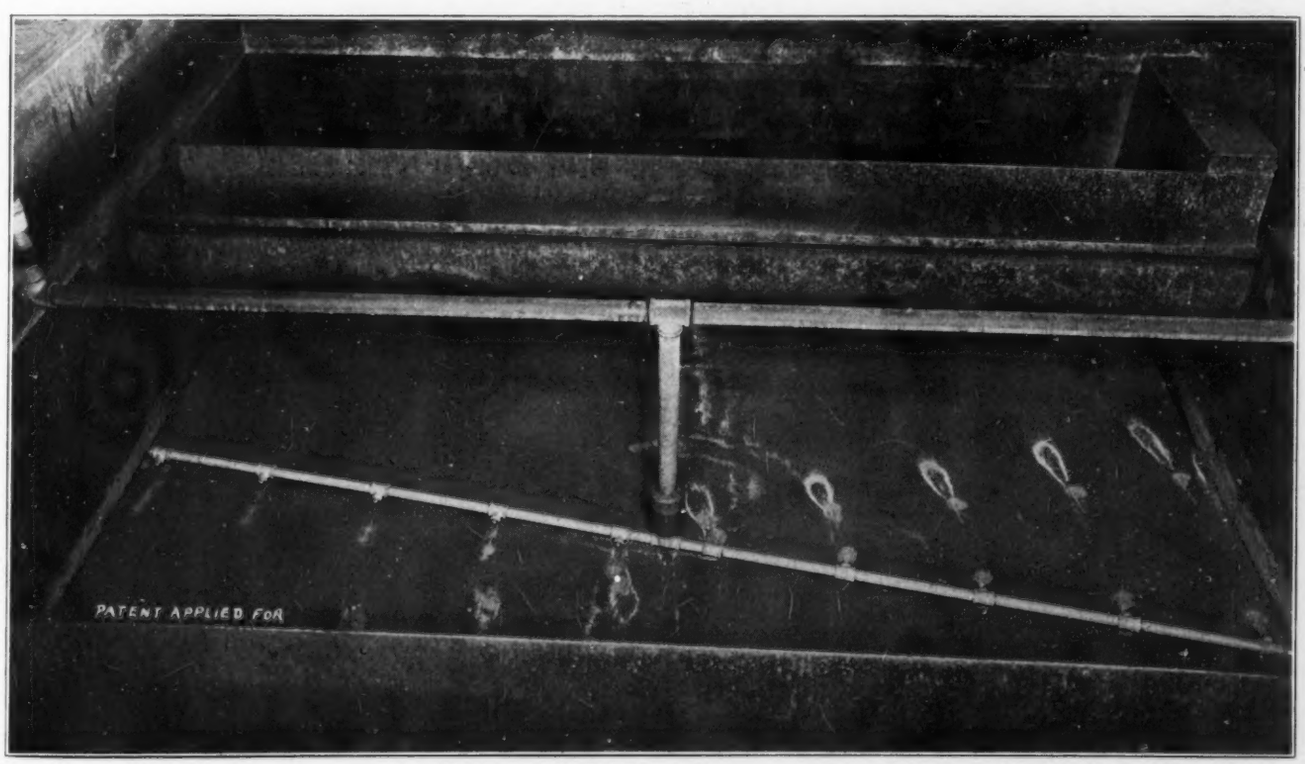
Research Engineer, The Anthracite Institute, Inc., State College, Pa.

The Author.

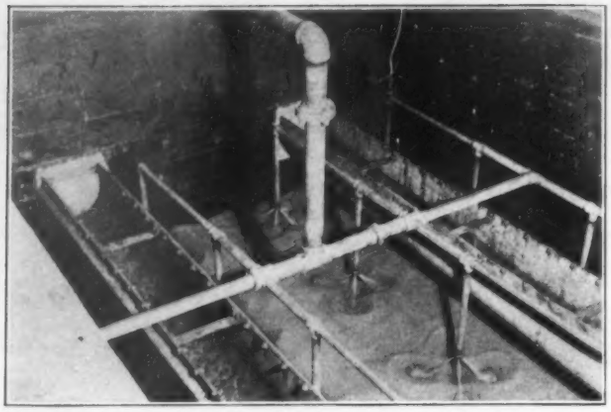
AT THE outset, I wish to explain that the title of this paper was chosen partly to arouse curiosity and partly from desperation. It does not describe adequately the context of the discussion, nor would any other title, for I expect to give you the conclusions from my observations and researches, from raw water to finished water, during several years of laboratory experiments and field studies, and some resultant conclusions. My keynote, however, is clean filters—why they should be, and why they are not. In the development of my theme I shall be very positive in making statements with which many may disagree. This is done for the explicit purpose of arousing constructive thoughts and action in connection with the filtration plants which the reader may design, operate, or serve in a consulting capacity.

Some Generalities

On several occasions I have made the statement that filters cost too much. For the sake of emphasis I make this statement again. What I mean is that they cost too much in proportion to the amount of work they do in the purification of water This aristocrat of labor (the filter) receives, so to speak, 85% of the payroll for doing 15% of the work of clarification. The remedy to this situation is not to neglect the pre-filtration treatment where 85% of the work is done, and where most of the work should be done, but to make a smaller total filter-bed area do the remaining job.



The Latest Development in Surface Wash Schemes. The Palmer Filter Bed Agitator in the Erie (Pa.) Plant is Self-Propelled by High Pressure Scouring Jets.



The Baylis Surface Wash System With Jet Heads Forming 2-Ft. Squares. (Developed in the Chicago Experimental Filter Plant; largest installation in Milwaukee's new plant.)

The most neglected part of the filtration plant of today is the filter. It is a sad commentary that, with all the advances in development of filter parts and adjuncts, and with all our increase in research and scientific knowledge, that most of the best filters in operation at the present time, from the standpoint of efficiency, are filters which were designed and built years ago. These early filters were crude, but seemingly the essential features of design were more nearly correct than are the essentials of filters being built right now.

In trying to find the reason for our present plight I have concluded that we have concentrated our studies too much on the separate parts of filters without enough thought as to relationship of such parts to each other. A filter consists of a bottom, a middle, and a top, the bottom being the various underdrain systems, false bottoms, etc., the middle being the gravel and the sand, and the top being the wash troughs.

In the following discussion I shall deal with the three component parts of the filter separately, with the understanding that my remarks are confined chiefly to so-called rapid sand filters and to some extent to pressure filters.

The Bottom

The chief function of the bottom of the filter is to effect a uniform distribution of backwash water. And, regardless of the type of bottom, greater uniformity of distribution can be secured in a small filter than in a large unit. Uniformity of distribution is not so perfect with a pipe system or perforated laterals as it is with a false bottom, and the larger the filter and the higher the backwash velocity, the more imperfect is the pipe lateral distribution.

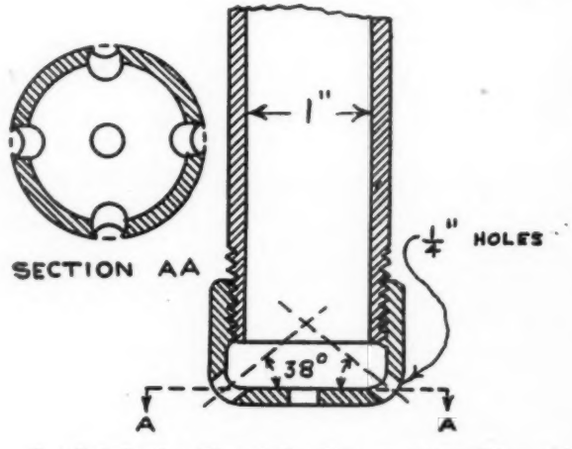
In my estimation, pipe laterals with drilled holes are better than those equipped with strainers. In such systems it is important to use strainers properly spaced along the tops of headers and to have the last pipe hole close to the end of laterals, to prevent dead spots along side walls of filters or over headers. I would not hesitate to use pipe laterals in small filters or in large filters that are equipped with some agitation device so that a low velocity wash can be employed. Where strainers must be used in any type of filter, they should be of a design having no small holes or slits. The simple umbrella type is the least likely to become clogged. The Wagner Block, used in connection with a lateral system, is more effective than the common practice of placing large pebbles between the pipes.

False Bottoms

There are many types of false bottoms in use today, but the best known ones are the Wheeler bottom, the Leopold bottom, the cement floor bottom with strainers, and the steel grating bottom. All of these bottoms give a very uniform distribution of wash water, the steel grating of the all-steel Morse Filter Plant being a recent development and a very simple and economical construction. It is important in any false bottom that there should be many closely spaced openings to prevent air trapping and, in general, the greater the space between the false bottom and the filter floor the better.

Time will not permit a discussion of all types of bottoms, but I must mention the "Aloxite" porous block bottom, because it is the most recent development and the only one that can be used without graded gravel. I have a feeling that this bottom may become quite important, but the method of installing the plates will no doubt have to be varied with the size of the filter. Whether or not the pores will become clogged seems to be an open question that time alone can answer; perhaps it would make no difference if it did clog, since removing the sand is such a simple matter that it would not be difficult to get at the clogged areas to clean them or to repair any defects which may appear. The plates being non-corrodible and not attacked by acids, alkalies or chlorine adds interest.

In conclusion, it is axiomatic that the greater the uniformity of backwash water, the easier it is to wash a filter clean.



Detailed Section Though Jet Caps on Down Pipes of Baylis System.

The Middle

The middle portion of a filter consists of graded gravel and sand or other filtering material. The function of the gravel is not alone to keep the sand from entering the underdrain system, but also to further disperse the water that comes from the bottom. Obviously the size of the pebbles and the number of layers depend on how much work the gravel has to do to finish the job that the bottom has started. Smaller pebbles and thinner beds can be used on a bottom that has already done a large part of the dispersing job. Pebbles 2 inches in diameter can be used to pack around pipe laterals but there is no need for pebbles larger than 1 inch in diameter above the top of the laterals or on top of most false bottoms. If a false bottom has closely spaced small openings the bottom layer of gravel can be made up of

½-inch pebbles. If of porous plates, no gravel is needed but a layer of coarse sand may be used to possible advantage.

The two most important gravel layers are the lowest one and the highest one. The lowest layer is frequently composed of pebbles that are too large to give much dispersion of wash water; in fact, they often channelize the water that has been well dispersed by the filter bottom. In most cases the lowest layer should be composed of pebbles not over 1 inch in diameter. The highest gravel layer gives the final dispersion of water that has come from below. For this reason this layer should be made up of pebbles not much over ⅛ inch in diameter and the thickness of the layer should be such as to permit it to be spread in a very uniform depth over the whole area. In addition to final dispersion of wash water the upper layer (commonly called pea gravel) has

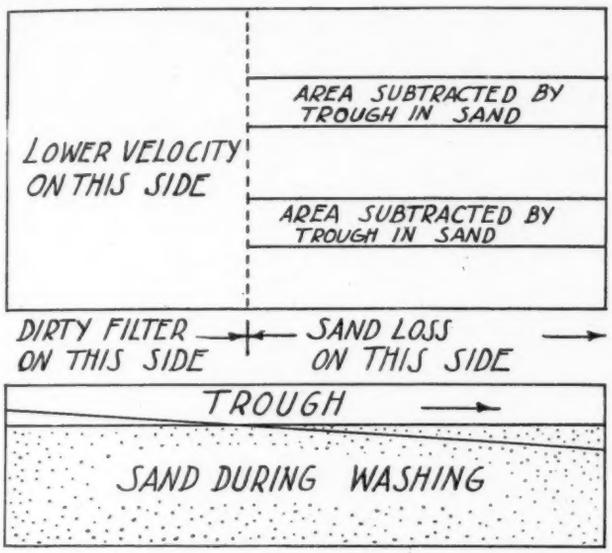

AREA SUBTRACTED BY TROUGH IN SAND
LOWER VELOCITY ON THIS SIDE
AREA SUBTRACTED BY TROUGH IN SAND
DIRTY FILTER ON THIS SIDE
SAND LOSS ON THIS SIDE
TROUGH
SAND DURING WASHING

Fig. 1. Sketch Showing Why Wash Troughs Should Not be Constructed Lengthwise of Filters.

the function of keeping the sand from being drawn down through the gravel. This is another reason why the pebbles should be small and uniform in size.

The most important part of the filter middle is the sand. The size of sand depends on the nature of applied water or other liquid, the depth of bed, the backwash velocity, the filtration rates, and particle shape. If the floc is poor or no coagulant is used the sand must be finer than would be otherwise required. If the filter is shallow so that only a thin bed (say 18 inches) can be used, the sand must be finer than that permissible in a 30-inch bed. Where high velocity wash is used the sand size should be such as to give a high degree of expansion (30 to 50%) without being washed out of the filter. If high filtration rates are to be used the sand should be coarse so as to obtain sufficiently long filter runs. If the particle shape is angular and somewhat flat the bed can be thinner than in the case of well rounded sand.

The relationship of sand sizes to bed depths has been worked out by Armstrong, Allen, and others. They show that the penetration of floc varies directly with the size of sand and in general that a coarse sand requires a deeper bed, while only a shallow bed is required for fine sand. As a result of their studies, coarse sands are now commonly used, but along with this change is a trend toward a thinner bed which, to my thinking, is inconsistent. As a matter of fact, higher filtration rates, longer runs, and more thorough washing could be obtained by going beyond the 30-inch depth, which is usually considered a thick bed.

In recent years there has been considerable research on the use of Anthrafilt, which is about half as heavy as sand. And magnetite, which is about three times heavier than sand, has been recently employed also. As a result of this work, Anthrafilt is rapidly replacing sand and to some extent gravel, while magnetite is being used in a few special filters where a magnet is used to produce expansion during washing. In other instances magnetite has been successfully employed as the supporting bed for Anthrafilt—notably in industrial water treatment, wherein silica is undesirable in the treated water.

Much could be written on this interesting subject of filter media, but time marches on, so it can't be done here. I do wish to leave the thought, however, that most filters with a bed depth of 27 to 30 inches can use Anthrafilt with an effective size of .70 mm, or an angular sand of .50 mm, with good results.

The Top

If the top of a government, the top of a business organization, the top of a school, or any other "top," is wrong, matters don't work out very well. A filter is no exception to this rule, and yet it is the "top" of the filter that, seemingly, has been given the least consideration. By the top of the filter I mean the wash water troughs, pipes, or what not for carrying off the water to the sewer.

It is impossible to cover, in a short space, a discussion of the many types of tops in pressure filters, so I shall confine my remarks to gravity filters. However, the same principles apply in both cases.

After years of effort, we have designed several filter bottoms that give a uniform distribution of wash water. But what good does this do if we place several baffels (troughs) in the top of the filter to break up the uniformity of flow from below, that has been secured with so much effort? I believe that filters would wash with greater ease and greater thoroughness if they were built in smaller sectional-wash units with overflow launders on the four sides and small cross troughs if any. The added cost should be amply offset by operating economies resulting from cleaner filters. It is reasonable to predict that such filters could operate at a 3 to 4 gallon rate per square foot, because there would be greater uniformity of filtration rate and greater uniformity of distribution of wash water throughout the smaller area below, and through the area above.

In any event, if troughs must be used, it is believed that these should be V-shaped and level on top and bottom. To give sufficient capacity, the sharp V can penetrate the sand for at least half its depth without operating difficulties. The object of the V shape is to present the least baffling effect on the rising water, and to give greater uniformity to the desirable increase in upward velocity of wash water as it enters the restricted area between the troughs. This would reduce to a minimum the eddies about troughs and permit the top of the expanded bed to be brought closer to the trough edge without loss of filter media, and less opportunity for the larger particles of dirt to drop back to the suspended filter bed below.

Troughs should extend parallel to the short diameter of rectangular filters instead of lengthwise, for a long trough must be too large if the bottom is to be level, or else it must have a bottom with a steep gradient, and this should be avoided for reasons shown in fig. 1.

Where high velocity wash is used there should be several small troughs closer together rather than a few large troughs far apart. This could be done without too much interference with the uniform turbulent sheet of water rising from the bottom if the troughs were V-shaped as suggested.

In trough design it should be kept in mind that they should have sufficient capacity to give a good weir action over the trough edge when the filter is washed at its maximum velocity. This, because the resulting horizontal currents must pull the heaviest clots or agglomerates of coagulated matter into the troughs before this dirt has time to settle back on the bed.

One outstanding mistake in filter "tops" is too much freeboard. Since high velocity wash has come to the fore, freeboard has been increased to guard against loss of sand. The average freeboard of 24 inches is one of the chief causes of dirty filters. Unless the top of the expanded bed comes to within 2 or 3 inches of the edge of the trough, when the filter is being washed at maximum velocity, it is impossible to remove large particles of coagulated material. The larger clumps of turbid matter will bounce up above the top of the floating bed to a maximum height of about 3 inches and, unless they are caught by horizontal currents at the top of their bounce, they will settle back into the bed to start mud balls.

To obtain less freeboard I do not advocate lowering the troughs, but I would advise adding to the sand even if it has to come up around the troughs. Troughs being shaped and placed as they are, you are bound to lose some sand with the proper lessened freeboard, so it amounts to taking your choice between washing your filters clean and losing some of the finer sand, or washing so as to never lose sand and having dirty filters.

[The author has to our mind struck home in his comments on the weakness of conventional filter "tops." It's like a dog chasing his tail; the higher the wash rate, the larger must be the troughs; the larger the troughs, the greater the up-flow velocity and interference by the troughs; the greater the up-flow velocity, the greater must be the free-board to avoid filter material losses; the greater the free-board, the greater the tendency toward mud-ball formation, and the dirtier the filter "innards"—all as a result of efforts to keep them cleaner. —ED.]

Filter Washing

After considerable laboratory study, coupled with many field observations, I have concluded that no filters that are doing all the work that they can, and should do, can be washed clean by conventionally applied wash water, regardless of the velocity used. Those filters that are operating with perfectly conditioned water, a high velocity wash, and a perfect bottom, come close to the proper degree of cleanliness, but they are loafing and would be very sick if they were required to do more work. Increase the turbidity of the applied water a thousand times; require runs of 75 hrs. between washes; step up the rates to 3 or 4 gals. per sq. ft. per min.; decrease the wash water velocity a little—and they can't take it.

Most of the early filters were provided with some form of bed agitator and they all washed clean when properly operated. This in the face of employing a low wash water velocity and operating on an applied water which would be considered terrible today.

The two most common forms of agitation were mechanical rakes and air wash. The mechanical rakes were cumbersome and unsightly and I don't blame water works engineers for discarding them. Air was often improperly admitted to the filter and, in many cases, was not left on long enough to do its job of sand scouring and breaking up the mud clots. The usual practice with air was to draw down the water until it covered the sand by 6 or 8 inches. The air was then turned on for 3 minutes and if it required 6 minutes of agitation to do the job it was just too bad. After the air was given its 3 minutes it was shut off and the wash water was turned on for about 5 minutes. Most operators using air did not realize that when the air was shut off the pipes were empty and the water in the filter rushed into this partial vacuum with such velocity as to drag the sand through the pea gravel into the separate air pipes or through the whole gravel bed into the underdrain

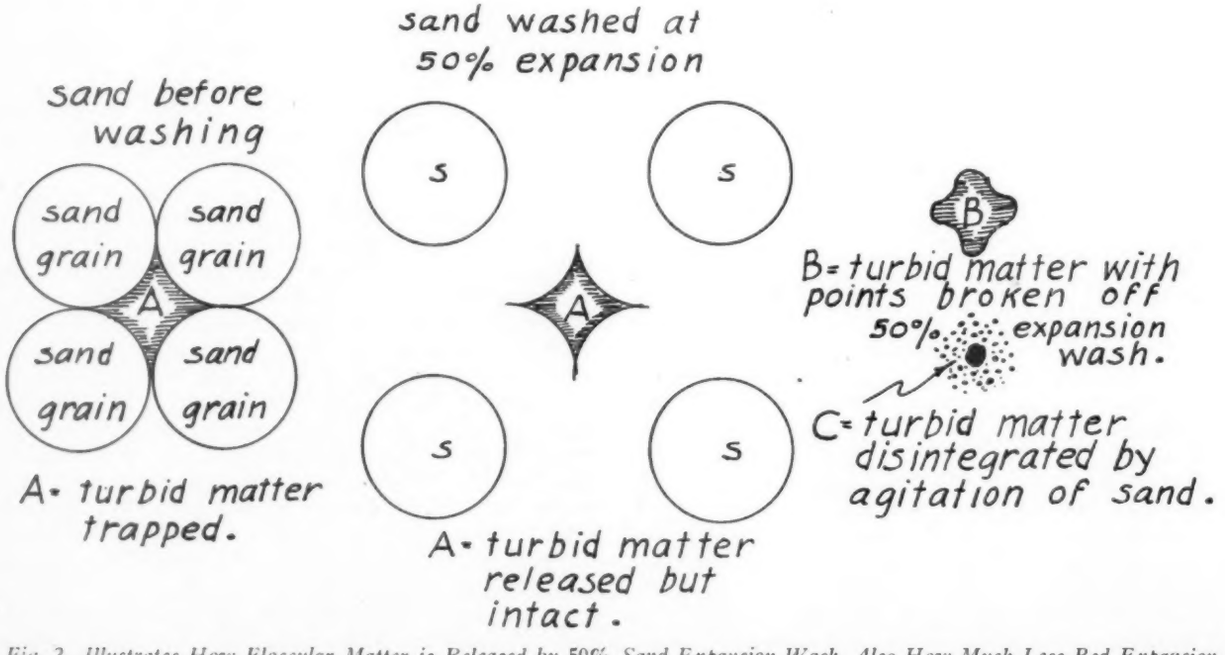


Fig. 2. Illustrates How Floccular Matter is Released by 50% Sand Expansion Wash. Also How Much Less Bed Expansion is Necessary to Release Floccular Matter (C) After Disintegration by Bed Agitation.

system. If the wash water is slowly admitted to the laterals as the air is being shut off there will be no trouble with sand being drawn down into the underdrain system or into separate system of small pipes if such are connected with a line to admit enough water to destroy the vacuum. Often a separate system of small pipes used for air was so insecurely anchored that constant slight movement caused breakage.

All these troubles with air, and probably a few more that have not been mentioned, caused the air-wash method to fall into ill repute, but many plants properly designed and operated lived on, and air-wash is returning to favor today. That some form of agitation is desirable, and that high velocity wash alone is not the answer, has become more and more evident, as indicated by the many recent papers on surface wash. [One such paper describing a simple, ingenious scheme appearing elsewhere in this issue.—ED.]

Other things being equal, a high velocity wash is necessary and desirable for washing filters clean. But other things are not equal and the solution seems to be lower wash water velocity plus some form of agitation to provide the scrubbing effect, while the up-flow serves only as the vehicle to remove the disintegrated dirt.

It has been suggested by Hulbert, Herring and others that a high velocity wash that will give 50% bed expansion will yield a clean filter. Well, it will give a cleaner filter than lower velocities or less expansion but it won't give a clean filter unless all other parts of the filter are correctly designed, and by other parts is meant bottom, gravel, sand, and troughs.

That a high degree of expansion is a factor in washing a filter clean can be shown by the following illustration: Suppose we assume that sand grains of a filter bed are in the position shown in fig. 2. It can be seen that the turbid matter "A" between the grains has the same diameter as the grains. If this piece of turbid matter is to be removed the grains will have to be moved apart by a distance equal to their diameter, which is just 50% expansion. Now the piece of turbid matter will have its thin edges broken off as soon as the bed is disturbed and will probably be reduced to condition "B," where 25% or 40% expansion will make a large enough doorway to let it out from between the grains of filter medium. If the piece of turbid matter

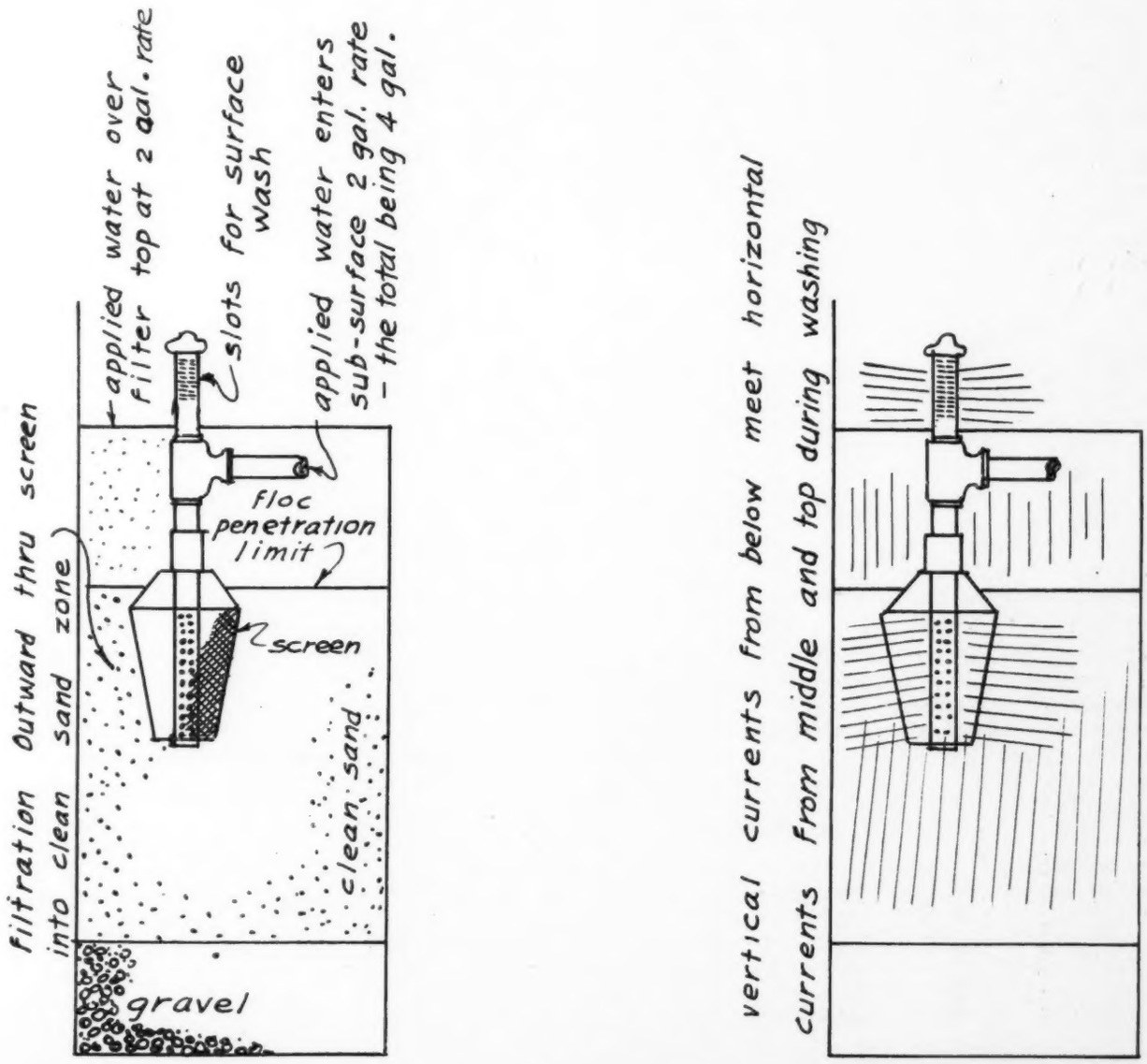

applied water over filter top at 2 gal. rate
slots for surface wash
applied water enters sub-surface 2 gal. rate – the total being 4 gal.
floc penetration limit
screen
filtration outward thru screen into clean sand zone
clean sand
gravel
vertical currents from below meet horizontal currents from middle and top during washing

Fig. 3. Jewe'l Sub Surface Filtering and Washing System.

is further broken up to a condition shown in "C," it can be seen that very little expansion is necessary, thereafter, to make doorways large enough to flush it out. The condition "C" is produced by agitation and shows why low wash velocities can operate efficiently with effective agitation. Of course, even in condition "C," the dirt and the nucleus remaining can be more quickly removed through doorways that are larger, so one shouldn't reduce wash water velocity to a point where the grains are not well separated in a wholly fluid bed.

If I had a filter which was not washing clean and the wash water velocity was about 18 inches rise per minute, I would not increase this velocity in the hopes of obtaining a cleaner filter, but instead I would install one of the available surface water jet wash systems or an air-wash system. The two objections to increasing wash water velocity in an old filter of this kind are: that the uniformity of wash water distribution would be decreased by forcing more water through laterals in a shorter time and that the wash water troughs, if not actually submerged, would be filled to a point where weir action is reduced to a minimum.

Surface Wash Systems

Most of you are familiar with the surface wash system developed by John R. Baylis some few years ago and now further improved, so I shall do no more than picture it.[1] The surface wash and sub-surface wash of the Jewell Sub-surface Filtration System has probably not been considered as an excellent method of agitation because the filtration part is usually strongly emphasized, whereas its washing value is not given enough emphasis. This system is, in my opinion, worth a great deal for application as a washing adjunct, entirely aside from the advantage to be gained by increased filter capacity.

The newest thing that I have seen in filter bed agitation is a system invented by C. E. Palmer, filtration plant engineer of the City of Erie, Pa., where the appliance has been operating with outstanding results. This apparatus, which I shall call the Palmer Filter Bed Agigator, although the inventor has not yet named it, is certainly a simple and efficient system. It consists of revolving pipe arms with self-propelling pressure scrubbing jets, as here pictured. By its use they really wash filters clean, using about half the wash water formerly required. A velocity of 24 inches rise per min. had been used, but filters were dirty. Mr. Palmer has protected his invention and has given me permission to picture it here and describe it briefly.

[Elsewhere in this issue is an article by C. E. Palmer, which describes the Erie design of a simplified and inexpensive surface wash scheme. To avoid duplication, Mr. Turner's description has been reduced to a sentence. Since the inventor has not named his device, we have dubbed it the Palmer "Filter Sweep"—but we can not guarantee that this name will stick any more than does the dirt in Erie's filters when it operates.—ED.]

In concluding this chapter, I wish to point out that a filter can be loaded beyond conventional rates if agitation is used; the type of bottom can be pretty sloppy; the wash water velocity can be low; the troughs can be improperly shaped; the freeboard can be too great; but in spite of all these faults the filter can be washed clean if the filter bed be effectively agitated.

(1) Fully described and illustrated by detailed sketches in Water Works & Sewerage Reference and Data Edition — May, 1936, page 197.

The Old Two-Gallon Rate—Why?

Somewhere along the line a filtration rate of 2 gals. per sq. ft. per min. was set as a standard maximum rate of filtration. This standard has been so firmly fixed that most water works men are reluctant to exceed it. Most of them do exceed it at times, but always keep their fingers crossed, and heave a sigh of relief when they get back to the so-called "standard" rate.

The two chief reasons why it is not safe to exceed the 2 gallon rate is that the sand is too fine and the filters are not being washed uniformly clean. Fine sand at high rates builds up head loss so fast that the increase in washing periods offsets, in a large measure, the gain from higher rates. In almost all filters that are set at a 2 gallon rate, the rate is so lacking in uniformity over the whole filter area that it may reach 4 or 5 gallons in the cleanest spots and be only a fraction of a gallon in the dirty spots. If a filter bed could be washed clean so that the rate would be uniform in all spots, and if the filter media were the proper size and shape, a rate of at least 3 gallons could be used at all times; and, more than likely a 4 gallon rate could be used with properly treated waters. That is one of the chief reasons why I always stress clean filters.

For those who do not wish to increase the capacity of their plant by stepping up the filtration rate through the adoption of agitation devices or new properly adjusted filter media, I recommend the Jewell Sub-surface Filtering and Washing System.

The Jewell System is designed to double the capacity of a given filter without, of necessity, exceeding the 2 gallon rate, through an ingenious method of filtering through the surface of the filter at a 2 gallon rate and at the same time filtering through the clean sand below the surface at a like rate. A sketch of one of the Jewell screens is shown in Fig. 3, which is sketched from memory and is probably not very accurately drawn.

We all know that there is little penetration of the average filter bed below a depth of about 6 inches, but who but an "old timer," like Mr. Jewell, would ever think of using this clean sand to filter through. He does what I have been talking about, and that is to make the filter earn its keep. The part of the system that makes the greatest appeal to me is that it offers an excellent method of agitation when the filter is back washed. The only addition that may be necessary in a plant that has its capacity increased by using this system is an increase in mixing and sedimentation space to take care of the double quantity of water filtered. Even this does not have to be as perfect as in a case where a filter is washed in the conventional way, because a filter with thorough agitation can be overloaded without getting into difficulties.

Retention and Pre-Treatment

A dissertation on filters would not be complete without a few words about pre-filter treatment and retention, which is of course such an important part of pretreatment. Aside from recommending a wider use of pre-chlorination as an aid to filter cleanliness, and better flocculation ahead of filters, I shall devote most of these few sentences to retention.

Sedimentation basins are of many shapes and sizes. Sufficient size is important, but shape has little to do with the results. If a body of coagulated water could stand absolutely still for 4 hrs. practically all turbid matter except the lightest floc would settle. But the water in a sedimentation basin is not standing still, for

water is always entering and always leaving. The important thing in a sedimentation basin is to have the water enter in a broad vertical sheet and leave in a broad vertical sheet, with the entering sheet being forced to the bottom by suitable baffling. The zone of entrance and exit should be half way down from top of basin. In this way the whole body of water will move forward very much as a unit and no restricted currents will be set up to give almost no retention to parts of the basin. This arrangement is taken care of in the Morse Filter Plant by entering manifolds and exit manifolds. Other filter plants in recent years have used this system, but most basins have the coagulated water entering at one point and leaving the basin also at one point and that is bad design.

Conclusions

Clean filters can be had, and maintained so, by agitation and moderate wash water velocities. Filters can not be washed clean by high velocity wash alone, unless they are perfectly designed or under worked. Pre-chlorination will assist in keeping filters clean. With clean filters, higher rates can be used with safety and longer runs can be secured. Filters which can be washed clean through agitation and moderate washing can be overloaded. Faulty design of bottom, middle, and tops of filters is not so serious where effective bed agitation is employed. Sub-surface filtration is sound and is successful because it embodies a system of filter bed agitation, hence a clean filter bed. In short, thus is procured filters with "innards" minus coli-aerogenes; less worries for operators; less concern for State sanitary engineers; fewer disappointments for designing engineers.

Acknowledgment.—The above paper, presented before the Maryland-Delaware Water and Sewage Work Association, was submitted for publication with approval of the Association. A choked schedule has been responsible for a regretted delay in the appearance of such an interesting and thought-provoking discussion.—ED.

▼

NO. P. W. A. AID IN CLARKSBURG'S WATER PROGRAM

(*Says Scotland Highland*)

On page 878 of our September issue appears a digest of Mr. E. S. Tisdale's remarks before the meeting of the Central States Section of A.W.W.A. which may be criticized for ambiguity, if not actual mis-interpretation, in recording Mr. Tisdale's informal review of West Virginia's progress in water and sewage betterments as the result of P.W.A. and W.P.A. aid. A sentence reads: "Also, impetus had been given to water softening as the outgrowth of P.W.A. assistance, Clarksburg and Parkersburg being the largest communities to adopt softening."

From Scotland G. Highland, General Manager, Water Board of Clarksburg, W. Va., comes the following note: "Referring to Mr. Tisdale's remarks, as reported in your September issue, Clarksburg did *NOT* ask for or receive P.W.A. aid. Kindly make proper correction in your next issue."

(This we are glad to do, Mr. Highland, and trust that we may be forgiven for what appears to be a mis-interpretation of notes of the reporter. The sentence should have been broken in two.—Ed.)

AMBIGUITY AN EDITOR'S PERIL

Mr. L. H. Enslow, Editor
Water Works and Sewerage
Dear Mr. Enslow:

W. C. Lawrence and W. R. LaDue are very much at a loss to understand the import of the caption under the former's picture on page 875 of the September issue of WATER WORKS AND SEWERAGE, which reads:

"W. C. Lawrence
Cleveland, Ohio
(Robbed of chairmanship, but elected
Vice-Chairman, Ohio Section)"

Two interpretations are apparent and possible:

First—That Lawrence was robbed of the chairmanship of the new Ohio Section by LaDue, the new chairman who acted as chairman of the Ohio Section Organization Committee, or

Second—That Lawrence, the vice-chairman of the old Central States Section and logically the incoming chairman of that Section, was deprived of that honor by the dissolution of the Central States Section.

As all of our many good Ohio friends know, the latter is the correct interpretation. *But,* and here's the rub, how many of the readers of your *good magazine* know that, and that we, Lawrence and LaDue, are the best of friends and are working shoulder-to-shoulder to put the Ohio Section where it belongs—among the best in the A.W.W.A. realm?

May we assure you that all of Ohio's new officers are working together in a spirit of unparalleled unity. Correction, please?

Yours in cooperation,
(Signed) W. C. LAWRENCE
(Signed) W. R. LADUE

(Knowing the Lawrence-LaDue friendship as we do, and all Central States Section members knowing it, it never occurred to us that any but the proper (second) interpretation of our "Robbed of Chairmanship" aside would be placed on it. More cautious would have been the use of the more peaceful word "Deprived" in the caption. We are extremely sorry for any possible mis-interpretation. Further proof of the Lawrence-LaDue friendship appears in our next issue. And, by the way, the Ohio Section is off to a great start, from all indications.—Ed.)

▼

FILTER PLANT SUPERINTENDENT AND ASST. SUPT. POSITIONS OPEN AT MILWAUKEE, WIS.

The Milwaukee Filtration Plant is nearing completion. The positions of Superintendent and Assistant Superintendent of Filtration are to be filled by competitive examinations to be held about the middle of November.

The salary set for the Superintendent starts at $3,600 and progresses automatically to $4,500 per year. That of the assistant's position starts at $2,700 and progresses to $3,420 per year. Milwaukee operates a retirement and disability pension system.

From the City Service Commission comes the advice that in planning this examination *local residence has been waived.* However, American citizenship remains a requirement in qualifying. The examinations are to be conducted in a manner to be worthy of the professional nature of the positions.

For further details, and notice of examination dates, address inquiry to H. W. Cornell, Sec'y, City Service Commission, City Hall, Milwaukee, Wis.

N. E. W. W. A. STAGES SECOND LARGEST CONVENTION

New England Water Works "Sentinel of Security"

THE 1936 Convention of the New England Water Works Association in New York City established a record for attendance at annual conventions of this association. Believed to have been the most unique and enjoyable of its conventions was that staged by N.E. W.W.A. last year, favored with "made to order" September weather in Maine, at famed Poland Spring. An all-round good convention and next to the New York meeting in recorded attendance (689) was that held September 13-16 in Boston.

The entertainment at Boston was all that could be asked for—with a dance the first night, a floor show and dance (smoker so-called) the second night, and the brilliant annual dinner dance attended by 573 members and guests the third night. On the second afternoon there was a cruise down the bay, and the ladies spent the closing day on an extensive sight-seeing trip ending with luncheon at Henry Ford's famed and historic Wayside Inn.

The Retiring President Warren J. Scott

The New President Geo. A. Sampson

John R. Baylis Honored

To address the association during its opening luncheon the first day came Boston's youngish mayor—Maurice J. Tobin. Massachusetts' governor, Chas. F. Hurley, scheduled to appear also, was represented by his chief of staff.

Then, as the principal event, followed the presentation of the Dexter Brackett Medal, which went to John R. Baylis, chemist in charge of the Experimental Filtration Plant of Chicago. As chairman of the Dexter Brackett Medal Award Committee, Linn H. Enslow, editor of WATER WORKS AND SEWERAGE, made the presentation and introduced the medalist. Explaining that, although the award had been voted to Mr. Baylis specifically in recognition of his paper, "Filter Bed Troubles and Their Elimination," presented before the association in 1936 and published in the March, 1937, issue of the Journal, Mr. Enslow cited the medalist for his numerous accomplishments and the valuable contributions which had come from the Chicago Experimental Filter Plant during his directorship. In addition to his work on filter bed troubles and developing measures of correction, Mr. Baylis was cited for eleven other contributions of importance in advancing water purification practices. Some of the more important had been the new widely practiced anti-corrosion treatment, involving water hardening (pH control) with lime; his pioneering work in taste and odor control with activated carbon, leading to methods of evaluating carbons and resulting in the production of improved carbons; the widely employed Baylis Precision Turbidimeter; the successful Baylis Surface Wash System, advancing economy and efficiency of filter washing; and most recently, his uncompleted work on silicates as aids or catalysts in improving and reducing coagulation and filtration costs.

The medalist was also cited for his more than 100 published technical papers; his 392-page text (1935), "Elimination of Taste and Odor in Waters"; also for his other honors, including the James Laurie Prize of A.S.C.E. and the John M. Goodell Prize of A.W.W.A. In so honoring John Baylis, Mr. Enslow said that he believed the association members would agree that it was but proper to pay tribute, also, to his superiors—those Chicago officials who had made it possible for the medalist to freely release, for the good of the profession, so much information of material worth developed while in charge of Chicago's plant.

Business Sessions

In the **Report of the Secretary,** FRANK J. GIFFORD revealed a total membership of 198 members, of which 22 are Corporate Members (Water Departments) and 102 are Associate Members (Manufacturers and Publishers). During the year there had been a net gain of 15 active and 10 associate members. Membership dues paid $5,657.25; in arrears, $887.50. Advertising fees paid, $3,035.65; in arrears, $378. The association had been running well within the budget set.

In the audited **Report of the Treasurer,** LELAND G. CARLETON (making his last report as Treasurer) re-

The Editor
Gordon M. Fair
(Harvard University)

New Vice-President
Leland G. Carleton
(Long-time Treasurer)

vealed that the association was in better shape financially than for several years, to-wit:

Total Receipts[1]	$10,387.54
Total Expenditures	10,205.58
Invested Funds	16,379.71
Cash in Bank	827.18
Total Assets[2]	18,386.29
Due the Ass'n[3]	1,284.00

[1]Includes $423.70 interest and dividends from investments.
[2]Includes office equipment, etc.
[3]Dues ($887.50), and advertising fees ($378) unpaid.

In the **Report of the Editor,** Gordon M. Fair revealed that the average circulation of the Journal per issue had reached 943, of which 145 represented non-member subscribers. It had cost $5.93 per member to produce the Journal during the year—the net cost, however, being but 69 cents per member. Offsetting a slight loss in advertising revenue, the Journal had been produced at a reduced cost of $200 (although containing more pages), due to a more favorable printing contract. In line with the gross cost of only $4,658.05 for producing the Journal in the year past, the current $5,500.00 Journal budget had been cut to $4,800 for the year coming.

The report of the **Legislative Committee,** presented by Chairman Arthur C. King, revealed that the members of the committee had reviewed 50 bills, followed 15 through committee, attended 10 hearings. In June, 1938, the lien law pertaining to water bills in Massachusetts had been re-written. Coming bills, to be watched, said Mr. King are being framed to require cities to permit fishing on water supply reservoirs. In fact, one bill of the kind had been passed over the governor's veto.

The report of the **Finance Committee,** presented by Chairman Donald C. Calderwood, amongst other things, offered a recommendation that a more modern system of accounting be installed in the association offices. A resolution to this effect was presented. It passed without dissent.

Responsibility for Interior Piping and Fixtures Brings Action and Reaction

The **Committee on the Advisability of Water Departments Regulating Water Piping and Fixtures with Buildings,** rendered its final report, as presented by Chairman Stephen H. Taylor; asked to be discharged; and was, with a vote of thanks. An allied committee, set up to cooperate with the American Water Works Association, Master Plumbers Association, and other interested groups, is being maintained with Mr. Taylor as chairman. Under way, he said, were plans to set up a special laboratory at the University of Iowa to test fixtures and set up standards covering such; also water supply piping in buildings. For final approval Mr. Taylor presented the resolutions as printed on page 476 of the December, 1937, issue of the N.E.W.W.A. Journal.

To that resolution, which might be interpreted as placing responsibility in the matter of inspecting and regulating interior piping and plumbing on the water utility management, there was considerable objection. As a result, changes were proposed in order to remove all possible interpretation that private water utilities or water departments were necessarily expected to take on such responsibility. With the minor changes the resolutions were passed without dissent.

In the form passed the resolutions merely state that "someone" should undertake the job of so regulating interior water piping and plumbing as to preclude back-

(A Press Photograph)

To John R. Baylis, the Dexter Brackett Medal. Presentation by Linn H. Enslow, Chairman of the Award Committee.

syphonage from fixtures and avoid inferior water service because of undersized or inferior piping.* The chairman (Mr. Taylor) was of the opinion that if the water authority was not in the position to act, he should see that someone did so in an effective manner. Plumbing codes usually failed to include any control over interior water piping other than drains and sewers.

President **W. J. Scott** said that, although the altered resolution now carried no direct responsibility, the water utility or water department should consider it a high moral responsibility to promote efforts at interior plumbing corrections and proper design of new installations. In the final analysis the water department head should have some degree of control in the matter, whether enforcement be directly under another department of not.

L. H. Enslow suggested that, as a happy beginning, the least the water works head should have is the privilege of review of plans and specifications and the power of veto, if found unsatisfactory after having passed the direct enforcement authority, whether it be the Building or Plumbing Inspector, or the local Health Department.

*Any reader desirous of a copy of these resolutions, as finally passed, may have such for the asking. Address the inquiry to The Editor—"Water Works and Sewerage," 155 E. 44th St., New York, N. Y.

Committee Progress Reports

Wm. R. Conard, chairman, presented a progress report for his Committee on Specifications for Cast Iron Pipe and Spirals, stating that revised specifications for pit-cast pipe were now ready but, more time would be needed on fittings and specials.

Richard H. Ellis, chairman of the new Committee to Collect and Tabulate Statistical Data, rendered his first report. He stated that the purpose was to collect data pertaining to operation and plant facilities for correlation and putting in a form for use of members and others. Sending out questionnaires to Massachusetts water works had gotten under way and, so far, the useful returns had been about 50 per cent. Other states would be covered in turn.

The President Recommends

In his address as retiring president, Warren J. Scott pointed to the value of more out-of-Boston meetings, and recommended more of such for the good of the greatest numbers of New England water works men. An important recommendation was that of setting up a Committee on Research and Water Works Practice, for the purpose of coordinating activities of the several technical committees of the association, and reporting in general review those important developments in the field of water supply, and summarizing progress made by N.E. W.W.A.'s technical committees. He also recommended the establishment of an Educational and Publicity Committee to publicize activities of N.E.W.W.A. and produce material which newspapers might use to acquaint the general public with the importance of water supply, thus advancing the local appreciation of water works managers and employees entrusted with water quality and continuity of consumer service. Another objective was that of removing water works operation and management from political interference. (This recommendation is along the lines started within the year by the American Association, from the headquarters of which is dispatched news items of interest concerning the association, water works operation in general, and individual members.—Ed.)

Directors

H. L. Clark, Supt. Water Distr., Sanford, Me.
H. L. Brigham, Supt. Water & Sewerage, Marlborough, Mass.
F. H. Kingsbury, Mass. Dept. Health, Boston, Mass.

Officers Elected

The following officers were declared elected for the ensuing year:

President—George A. Sampson, Cons. Engr., Boston.

Vice-Pres.—Percy A. Shaw, Supt. Water, Manchester, N. H.

Vice-Pres.—Leland G. Carleton, Registrar, Springfield, Mass.

Secretary—*Frank J. Gifford, Cons. Engr., Dedham, Mass.

Treasurer—Abel Reynolds, N.E. Associates, Providence, R. I.

Directors—*F. H. Kingsbury, Boston; *Harold L. Brigham, Marlborough, Mass., and Horace L. Clark, Sanford, Me.

*Elected in previous years.

Technical Sessions

(President—Warren J. Scott, Presiding)

The technical sessions were opened with a paper by William L. Lumbert, Supt. of Water, Scituate, Mass., descriptive of **"The New Butt-welded Steel Standpipe for Scituate."**

Completed April 30, Scituate's new standpipe, built by Pittsburgh Des Moines Steel Company, is 55 ft. in diameter, stands 70 ft. high, has a capacity of 1,500,000 gals. No standard specifications for the butt-weld construction being available, tentative official specifications and records of steel fabricating companies were drawn upon in preparation of specifications and weld testing procedure, both being discussed in the paper. A nine-course ring construction was chosen, with vertical seams staggered one-third the length of the open-hearth plates; the upper courses being 5/16 in., the lower course 3/8 in. and foot plates 11/16 in. thick. Between the concrete base and bottom plates (welded in position) was laid a cushion 1½ in. thick of cement and sand mixed in equal parts. The roof-plates (3/16 in.) are of copper bearing steel. Mr. Lumbert then described the method of planing the edges of the plates and the exact method of arc-welding, selected on the basis of test specimens prepared. The floor and roof plates were lap-welded. In all, only 22 working days were required in placing the 154 tons of steel and completing 3,953 ft. of welding, requiring better than one ton of welding rods. By tests, the correct thickness of weld metal was determined on the job. Too heavy a weld was found to create more stress than desired. In horizontal seams the weld metal was placed from the outside, vertical seams from the inside. When filled with water the side walls bulged 1/8 in., per calculated expectation.

Although 1/16 in. had been added to all calculated plate thicknesses as a corrosion factor, great care was used in selecting and applying the protective coating. The prime coat had been applied only to freshly sand-blasted surfaces, although the priming paint selected for

On the Boat Trip

(1) *A. O. Doane (Newtonville, Mass.), F. K. Gidley (Fairhaven, Mass.), Robt. S. Weston (Boston); (2) Mr. and Mrs. Arthur King (Taunton), Mr. and Mrs. Leland Carleton (Springfield), Mr. and Mrs. Herbert Jacobs (Lynn); (3) H. V. Macksey (Brookline), W. C. Hawley (Wilkinsburg, Pa.); (4) Mr. and Mrs. M. E. Quirk and Mistress Helen (Peabody); (5) Maurice Libby (Bath, Me.), Mr. and Mrs. Chas. Pool (Providence); Mr. and Mrs. Hal Hutton (Newark, N. J.); Mr. and Mrs. Chas. Richardson (Providence) et al.*

On the Boat Trip

(1) Al. Lash (Mattapan, Mass.); H. J. Cook (Auburn, Me.) and their "betters;" (2) Rockwell, Angell, Arnold, Johnson et al.; (3) Mrs. Walter Hersey (white hat), the others have us licked; (4) A-"stearn" conference was held by Danvers' Roger Esty and their Consulting Engr., E. T. Killam (New York); (5) Russ Scott, M. F. Abrams, G. E. Boyd (New York).

the first two coats (Feroleum B.L. 20 S.) has the property of combining with thin films of rust. The third coat on the interior was Feroleum Marisol No. 10 Black; on the exterior Feroleum Algonquin Gray, supplied by Feroleum Products Company of New York. Mr. Lumbert's paper discusses several details, of practical significance, in surface preparation and paint application. Lantern slides in color revealed welding details, construction and painting progress.

"The Surface Water Supplies of Massachusetts," by Francis H. Kingsbury, Senior Sanitary Engr., Mass. State Department of Health, Boston.

Mr. Kingsbury's paper, presented in abstract, constitutes an interesting historical record of the public water supplies of Massachusetts derived from surface sources. Interesting was the fact that the earliest attempts at filtration involved mechanical straining. In 1875 Spring-

R. H. Ellis, Engr., Factory Mutual Inc. Co., Boston.
W. J. Lumbert, Sup't Water, Scituate, Mass.
A. D. Weston, Chief Engr., Mass. Dept. Health, Boston.

field had box filters filled with excelsior. Then a little later there was a filter consisting of a well with concentric walls located within a pond. Between the walls was placed sand and, interestingly, the unit was designed for back washing. Slow sand filters came later, the first being at Lawrence in 1893, and still in service on Massachusetts' most polluted source of public supply—the Merrimac River. Now Lawrence had under construction rapid filters to precede new slow sand units. As to rapid type filters, Athol installed pressure type units in 1887, but no other such plants were constructed for another 35 years. Then in 1922 the Cambridge plant was built. This indicated what Massachusetts thought of "chemical-doctoring" of its drinking waters. Even now, there are only 11 rapid sand plants, with prospects that such a plant will go in at Danvers, Mass., and possibly one other.

As to chlorination, such had started in 1918, had been slow to be adopted until recent years in Massachusetts, where the axiom had been clean water supply from protected and policed water-sheds. Even now chlorination, where needed, is not considered sufficient alone and use of water-shed and reservoir areas as recreation grounds must continue to be frowned upon by health authorities and fought by the water supply fraternity of the state.

In reviewing water quality from surface sources in Massachusetts, graphs revealed predominantly soft corrosive waters with color varying from 5 to 173 p.p.m. and maximum hardness of 71 p.p.m., appearing in the northwestern corner of the state. With high color usually went high iron content, to add more troubles. Only 40 per cent of the supplies ran higher than 20 p.p.m. hardness; only 12 per cent had color in excess of 40 p.p.m. As to corrosiveness, 80 per cent had acid values below pH 7—this property constituting one of the chief problems. But, on the other hand, 95 per cent of the ground water supplies were even more corrosive, many having objectionable iron content in addition. In respect to the future of water purification in Massachusetts, it was evident that filtration, iron removal, and anti-corrosion treatments would advance to meet the growing demands of the public for waters meeting higher aesthetic standards, continuously palatable and less objectionable in corrosivity.

"Ground Waters in the Buried (Pre-Glacial) Valleys of Massachusetts," by I. B. Crosby, Consulting Geologist, Boston, Mass. (Read by the Secretary.)

In this paper, of interest to eastern Massachusetts communities and industry, Professor Crosby revealed known locations of pre-historic river valleys, now filled with over-burden brought down and left by glaciers covering what is now the densely populated northeastern area of the state. These valleys (some now hills) contained a series of buried "lakes," and were excellent ground water reservoirs having little or no movement of their waters "down stream." Location of ground water supply in these areas could be exactly done by geological methods, involving use of several seismographs (on location) detecting directional travel and speed rates of earth vibrations created by scattered dynamite blasts. In one case referred to this scheme had indicated overburden depth of 114 ft., at far less cost than the boring survey, which confimed the depth at 115 ft.

Cost of Water Supply in New England

(A Symposium—Frank A. Barbour, Presiding)

The chairman explained that it had been the hopes of the program committee to be able to derive cost data covering construction and operation of water systems of varied types and magnitude in such a manner as to compare these costs on a basis of some standard unit, such as per capita served, or per capita costs based on capacity of the system. With this aim in mind the present group of papers were being offered as a start.

"The Cost of Small Surface Supplies," by Geo. A. Sampson, Weston & Sampson, Engineers, Boston, Mass.

Mr. Sampson presented a splendid analysis of costs of small surface supplies, pointing out that the year 1916 seemed to be the dividing line between low costs of former years and rapidly mounting costs afterwards, in parallel with the cost of cast-iron pipe, which rose from $21.00 per ton in 1914 to the 1920 all-time high of $71.79 per

ton, dropping to $31.00 in 1932, and since on the upgrade to $48.00 at the close of 1937. (Recently, however, cast-iron pipe has dropped $4.00 per ton, which did not appear on the price trend curve shown by Mr. Sampson.—ED.)

Since the purpose of the paper was to present a general method of estimating costs, Mr. Sampson had selected average conditions, taken as the basis. For costs, 1937 prices had been used, to which a factor could be applied for previous years. The assumptions were: mains of centrifugally cast Class 150 B. & S. pipes with cement or bitumastic linings. For joints, lead substitute and ½-in. square braided yarn. He then discussed the several various items which had to be considered. Such were the nature of the source of supply and need for protection or purification; pumping vs. gravity; secondary storage (tank or service reservoir); length of supply main and minimum size; details of the distribution system as one of the most important cost factors.

In selecting some common unit as the measure in cost comparisons, the following had been considered and weighed—(1) Per capita cost, based on population served; (2) Cost per service; (3) Cost per M.G.D. capacity of the system. In the end, *cost per capia served* seemed to be the best unit or standard for comparisons fellow says, 'bring me a blank check'—that's our most of modern systems and, also, the most accurate for applying in cost estimates. A study of 12 surface supplies revealed the average "per capita served cost" to be $23.00 (ranging from $10.00 to $60.00), with 8 of the 12 falling between $15.00 and $30.00 per capita served. On the other hand, costs of distribution system, which represented from 65 to 75 per cent of the whole cost of modern systems, might be determined with reasonable assurance of accuracy. Considering populations served between 500 and 17,000, requiring between 6 and 76 miles of mains with a minimum of the 4-in. size (9 per cent), the average completed cost at present prices was reasonably close to $1.93 per lineal foot, when lumping mains of all sizes involved. Substituting 6-in. for 4-in. mains raised the figure by only $0.03 per foot average. His cost table indicated laid costs of $1.23 per foot for 4-in., $1.56 for 6-in., $1.98 for 8-in., $2.48 for 10-in., $3.04 for 12-in., $4.31 for 16-in., $5.87 for 20-in., $7.70 for 24-in., $10.90 for 30-in. For fittings and specials (Bitumastic lined) 2.5 cents to 6.5 cents had been added per foot of main—the average for all sizes being 4.5 cents per foot laid. Gate valves and valve boxes add approximately 6 per cent to the cost of the pipe. Such represented 8 cents per lineal foot as the average, the range being 4 to 14 cents. Hydrants and their gate valves on 6-in. connections averaged 13.6 per cent of the cost of pipe for 32 systems. For hydrants, the added cost per lineal foot of mains averaged 17.5 cents, the range being 11.5 to 26.5 cents. Considering total costs of all mains in the systems studied (including everything), such had varied only from $11,000 to $12,500 per mile—averaging $2.38 per lineal foot.

As to the costs of consumer service lines complete to the curb box (average length of 30 ft. of corrosion resistant service pipe), the average cost would be $38.00 per service at present prices, amounting to $9.00 per capita for residential services. Added, should be the meter cost of $13, amounting to $3.00 per capita. Cutting paved streets added 50 cents to $1.50 per lineal foot of cut. Finally, to the computed construction costs should be added about 15 per cent to cover preliminary expenses, engineering, contingencies, interest during construction.

Mr. Sampson closed by exhibiting two interesting cost graphs in which No. 1 revealed the trends in total costs for various populations served between 500 and 18,000 and No. 2 revealed the trend (or lack of such) in cost per capita for systems serving the same range in populations served—the average being $160 per capia for the 500 to 1,000 populations, to $100 per capita for the 16,000 to 18,000 populations served. These diagrams, computed on actual costs of systems transposed to 1937 costs, are accompanied with an index for converting to costs of any year from 1909 to 1937. Interesting was the fact that systems costing $100,000 today to reproduce had cost only $50,000 if constructed in 1914-1915; $130,500, if in 1920; $78,300, if in the lowest cost year since, namely in 1932.

"Cost of Ground Water Supplies," by PAUL F. HOWARD, Whitman and Howard, Engrs., Boston, Mass.

Mr. Howard reviewed and discussed methods of developing ground water supplies, and presented some-

Caleb M. Saville, Chief Engr., Water Distr., Hartford, Conn.
Sheppard T. Powell, Cons. Chemical Engr., Baltimore, Md.
Frank A. Barbour, Consulting Engr., Boston (Symposium Chairman—"Water Supply Costs").

thing as to comparative costs from recent records on New England well supplies. In his opinion, based on experience, no ground supply should be considered satisfactory if not capable of yields of 800 gals./capita/day, for a single day; or 600 gals./capita/day for a period of seven consecutive days. From batteries of driven wells 10 g.p.m. per well seemed the safe limit and 7 g.p.m. was a safer average yield to rely upon. The difficulty and important factor was that of maintaining a uniform pull on every such well on the suction headers. He cited the

"Halves and Better Halves"

(1) *Roger Esty, Supt. Water, Danvers, Mass., and Mrs. Esty;* (2) *H. L. Field, Supt. Water, Greenfield, Mass., and Mrs. Field;* (3) *Henry Salomon, L. A. Salomon & Bros., New York, and Mrs. H. K. Sloane (Boston);* (4) *The President, Warren J. Scott, Chief Engr., Conn. Dept. Health, and Mrs. Scott;* (5) *"Sid" Anthony, Supt. Water Distr., Augusta, Me., and Mrs. Anthony.*

"Halves and Better Halves"

(1) "Don" Foster, Supt. Water, Wilmington, Mass., and Mrs. Foster; (2) W. A. Helbig, Chemical Engr., Darco Corp., New York, and Mrs. Helbig; (3) The 1st Vice-Pres., Percy A. Shaw, Supt. Water, Manchester, N. H., and Mrs. Shaw; (4) Charlie McGinnis, Mgr., Transite Pipe Div., Johns-Manville Co., New York, and Mrs. McGinnis; (5) M. F. Wirtz, Pres., Atlas Mineral Prod. Co., Mertztown, Pa., and Mrs. Wirtz.

time consumed and costs of putting down and pumping driven test wells; the resulting economies and high dependability experienced in going direct to gravel packed wells, tested and developed after construction. A worthy advantage of the gravel pack well was its ability to more effectively utilize the ground storage and stand variable rate pumping, without affecting water quality or operating costs. Reduced maintenance costs was another factor in their favor over driven wells. Since the rate of lateral water draft was 7 ft./min. in the vicinity of the strainer of driven tubular wells, as against only 5 ft./min. for gravel packed wells, the latter suffered less from carbon dioxide and iron and manganese troubles under normal to heavy pumping rates; also, in the matter of corrosivity of water produced.

Concerning well construction costs, Mr. Howard cited the following:

		Yield	Instal-	Total
Dug Wells	Size (ft.)	(G.P.D.)	lation	Cost
Canton, Mass.....	35 x 20 deep	400,000	$15,000*	$17,000
Newton, Mass.....	20 x 33 deep	1,000,000	17,500	.....
	20 x 40 deep	1,000,000	.....	.....
Tubular Wells				
Yarmouth, Mass.....	14—2½ in.	350,000	$5,894	$16,000
Buzzards Bay, Mass..	25—2½ in.	400,000	6,909	25,000
Townsend, Mass.	35—2½ in.	430,000	8,875	33,000
Gravel Packed Wells				
Harwich, Mass., 4 wells..... (52 in. x 36 ft.)		720,000	$ 6,547	$38,000
Cotuit, Mass., four wells.....		720,000	7,700	38,000
Needham, Mass., one well.....		1,000,000	8,600	30,000
Woburn, Mass., 3 wells.....		6,250,000	189,000	.....

From the figures cited, the costs of developing three tubular well supplies varied from $1,680 to $2,080 per 100,000 g.p.d. developed. Total costs per 100,000 gals. developed were: Yarmouth, $4,500; Buzzards Bay, $6,200; Townsend, $7,600. The costs of developing 100,000 g.p.d. from gravel packed wells were: Harwich, $1,430; Cotuit, $1,070. The savings were due in large measure to elimination of preliminary costs of test wells developed for yields and water quality. The total costs per 100,000 gals. (complete systems) was very nearly the same—roughly $5,300.

*Exclusive of cost of preliminary test wells.

Geo. W. Booth, Ch. Engr., Natl. Bd. Underwriters, New York.
Wm. R. Conard, Consulting Engr., Burlington, N. J.
W. D. Collins, Chemist, U. S. Geol. Survey, Washington, D. C. (Symposium Chairman—"Water Quality and Uses").

From the above cost analysis Mr. Howard pointed out that no general conclusion as to which type of well development was to prove the most economical could be stated. However, there were other more important considerations in the choice of type of mill.

"Cost of Distribution Systems—Their Operation and Maintenance," by Wm. W. Brush, Editor, "Water Works Engineering," New York City.

Mr. Brush listed 12 factors and variables to be considered in evaluating and comparing costs of distribution systems. He favored the inch-mile unit in computing distribution systems, but such data were not available in New England. The following figures were presented as representative of Chicago conditions involving cast-iron pipe.

Main Size	Cost Per Foot Laid
6-in.	$1.45—$ 9.08†
8-in.	4.48— 9.08†
12-in.	5.88— 10.65†

From Hartford, Conn., the following for laying cast-iron pipe in 1930:

Cost Per Foot

Inches	Material	Total	Costs Per Inch Diameter
2	$0.57	$1.33	$0.67
4	0.71	1.32	0.33
6	0.85	1.70	0.28
8	1.23	2.30	0.28
10	1.95	2.75	0.28
12	2.14	4.13	0.34
16	4.78	8.64	0.34

In addition, an overhead charge is computed as 23 per cent, on combined labor and material costs. For pavement cutting and replacement, add $3.00 per foot.

Indicative of variations in cost of cast-iron pipe installation at various points, Mr. Brush cited figures to show that at Louisville, Ky., costs in 1930 were from 70 to 74 per cent below those of Hartford.

Discussing maintenance and operation costs, Mr. Brush discussed the various factors in management which entered to give marked variations in reported operating costs—principally labor, emergency service, leak surveys and repairs, meter testing. In reply to requests for data, fourteen New England managers had supplied information covering cities of between 11,000 and 500,000 population. For meters and services the data were too fragmentary for an analysis on any common unit basis. Distribution system costs and maintenance and operating costs, when broken down to a per capita basis, revealed the following: (1) Construction costs per capita varied from $24 (Fairhaven) to $69 (Boston) and $12,000 to $16,000 per mile, without any general trend based upon size of community; (2) Maintenance and operating costs

†The higher cost in each case is that for laying mains in improved streets.

seemed to vary from 26 cents to $4.56 per capita, but without any defined relationship to size of system. New Bedford made the fine showing with $29 per capita for main construction costs and 34 cents per capita for maintaining and operating its distribution mains. Seven cities reported figures in the range of $1.50 to $2.50 per capita.

Discussion

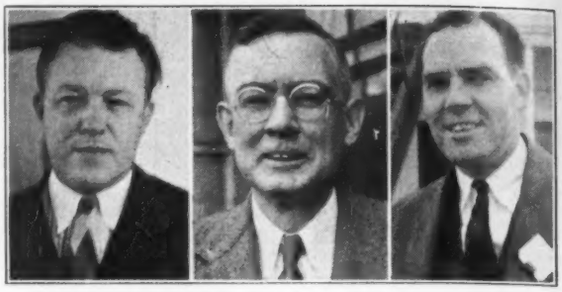
As to be expected, these three initial cost papers brought forth much discussion and argument concerning variables under different conditions which would render comparisons of one system with another (on most any basis) a difficult matter, requiring much interpretation. The chairman pointed out that the extreme spread in per capita operating and maintenance costs, as given by Mr. Brush, needed further clarification.

Some thought the more rational unit, in both system cost and operating costs, to be per m.g.d. *capacity* and m.g.d. *consumption;* others thought the number of service connections, or "per capita served cost," the better yard stick in making estimates, or comparing system against system, year against year, and size against size.

Karl R. Kennison (Boston), **Caleb M. Saville** (Hartford) and **E. S. Chase** (Boston) pointed out that modern methods and improved materials now used in water systems, and increasing purification, had materially boosted present day costs. Thus comparisons with the past would be of questionable value, regardless of the basis used. Likewise, old revamped and amplified systems or plants cost more (on any basis) than those constructed all at one time.

An example in comparative storage reservoir costs, cited by Mr. Kennison, showed that the earlier Boston reservoirs cost $130,000 per m.g.d. yield as against $216,000 for the Quabbin, and $240,000 for the Ware-Swift River reservoirs. In comparison, the Hartford reservoir cost only $57,000 per m.g.d. safe yield.

W. C. Hawley, General Manager, Penna. Water Company, Wilkinsburg, Pa., thought that results, within limits, might be gotten by the studies started by the association. He stressed the fact that with increasing construction costs, due to modern equipment and methods, operating and maintenance costs had gone down. One example was the better grade of cast-iron pipe produced in recent years under careful foundry inspection and control, consequently less main failures and repair work involved. The doing away with wiped lead joints (invention of the devil) and adaptation of flexible mechanical joints, and trouble-free service piping, had been another factor to send the trend of maintenance costs increasingly downward. One other important factor was overhead, store-keeping and bookkeeping, which ran costs very high unless some standardization of valves, hydrants, meters had been adopted. In short, what might appear an overly costly system, on *any* unit basis, might readily be the more economical system in the final analysis. (Mr. Hawley's comments and reasoning as a long-experienced manager of a private water utility sounded meritorious to his audience.—Ed.) **Percy Shaw,** Superintendent, Manchester, N. H., also commented on the need for considering the first cost as a part of resultant (operating plus carrying) costs.



E. T. Killam, Consulting Engr., New York.
E. S. Chase, Metcalf & Eddy Engrs., Boston.
D. C. Calderwood, Engr., Pennichuck Water Co., Nashua, N. H. (Chairman of Finance Committee).

E. T. Killam, Cons. Engr., New York City, reported his experiences in cost studies by graphical methods. The finding that there was no defined relationship between cost of system per capita served, or per m.g.d. consumed, and size of community served, had been a surprise. The reason was found to be in differences in quality of materials in the system and also in the costs for extensions and betterments added during years subsequent to the original construction.

Paul F. Howard, Cons., Engr., Boston, was still of the opinion that the fairest index in comparison and estimates was on the service connection basis, rather than per capita served or yield of the supply. Variations in costs of several systems, familiar to him, had been within 10 per cent either way of an average cost of $18,000 per mile of main.

It was the general impression that at least a start in cost comparisons had been made; that figures on individual systems, when employed in analyses and reporting of costs, needed some interpretation and explanation by those with first-hand knowledge of conditions; that the data being collected by the Committee on Statistical Data would prove of value; that more papers on cost analyses should be arranged, in order to clear up some of the questions raised and amplify the picture.

Miscellaneous Uses of Water

A Symposium—W. D. Collins, Presiding

W. D. Collins, Chemist, U. S. Geological Survey, Washington, D. C., introduced the topic of water quality to meet industrial requirements, with one of his very interesting graphical presentations with charts and color strips to picturize the difference in water quality from various sources in the United States, and its meaning to industrial users; also, concerning water temperature and its meaning in air conditioning. Mr. Collins stressed the

(1) "U. S. Pipers"—H. A. Hoffer and Lloyd Nelson, Philadelphia; (2) "Birds of a Feather"—all "Supers"—"Steve" Taylor (New Bedford), Howard M. King, (Springfield), Frank T. Gidley, (Fairhaven); (3) "Vic" Arnold, Pres. Phoenix Meter Co., (Brooklyn, N. Y.), "Ed" Johnson, Sales Mgr., and Col. W. F. Rockwell, President, Pittsburgh Equitable Meter Co., (Pittsburgh); (4) "Don" Calderwood (Nashua, N. H.) puts a valve problem to W. A. Dallach (left) Mgr. Water and Sewage Div., Crane Co., Chicago; (5) Howard M. King (Springfield) and S. S. Perry (Boston) Sales Engr., Worthington Pump and Mach. Corp.

(1) S. J. Kyle, Supt. Ansonia (Conn.) Water Co. and W. P. Schwabe, Mgr., Northern Conn. Power Co., Thompsonville, Conn.; (2) J. B. McFarland, Publicity Director, U. S. Pipe & Foundry Co., Burlington, N. J., and D. W. Johnson, Engr., Cast Iron Pipe Research Assn., Chicago; (3) Jack Diven, Distr. Mgr., Leadite Co., New York, and W. R. Conard, Cons. Engr., Burlington, N. J.; (4) R. W. Sparling, Pres., Sparling Meter Co., Los Angeles, and "Hal" Hutton, Ass't Mgr., Wallace & Tiernan Co., Newark, N. J.; John Ward, Dist. Mgr., Rensselaer Valve Co., Troy, N. Y., and "Bill" Birch, Pres., Birch Mfg. Co., Chicago.

fact that a single chemical analysis of a surface water might give such misleading results as to be worth less than nothing.

"Water Quality Requirements for New England Industries," by Hervey J. Skinner, President, Skinner and Sherman, Inc., Boston.

Mr. Skinner, in touching on the deleterious effects of sewage polluted streams on the fiber industries (pulp and paper mills and textile plants), stressed the growing need for control of biological growths in the pipe and vat systems, commonly termed "slimes," and costly in their destruction of fiber stock or damaged appearance of finished products. The adaptation of chlorination, and particularly the ammonia-chlorine treatment, had been the most effective corrective increasing in application with proof of merits. The process had also been effective in control of insulating slime growths on or in steam condenser tubes.

In textile manufacture and high grade paper production color and turbidity in amounts above 5 p.p.m. proved objectionable; iron content of not over 0.2 p.p.m. and manganese was objectionable in even lesser amounts. Hard waters produced insoluble soaps and resinates, to produce streaky piece goods (wool, rayon, cotton) and poor dyeing resulted; silk became hard and brittle. In paper and pulp production, waters of much higher hardness were acceptable, but any color, iron, etc., would be adsorbed on the fibers which in truth purified the waters by "floating filtration."

Mr. Skinner then touched on softening methods, Zeolite softened water of zero hardness paying in production of textiles, whereas for paper production ordinary filtration, or iron and manganese removal was sufficient.

"Developments and Trends in Industrial Water Treatment," by Sheppard T. Powell, Consulting Chemical Engr., Baltimore, Md.

Mr. Powell briefed his voluminous paper in splendid style—using lantern slides to picture novel designs of compact industrial supply purification systems. Particularly interesting were the tank baffling arrangements applied to economical circular tanks employed as coagulating and clarification units. In another design small circular units, involving tangential inlets resulting in spiral-flow, created rapid settling of sludge and complete displacement and clarification effects in 1 hour, superior to that obtained with 4 hours of quiescent settling. Another improved scheme was a modification of Spaulding's "Precipitators," in which the lime treated raw water passed upwards through conical bottom settling tanks containing a sludge "blanket" of precipitated hardness. Line drawings of the "Precipitators" and International Filter Co.'s "Accelator" were shown on the screen in describing their functions, involving a sweeping out of colloidal precipitates by the suspended sludge particles.

Silica sand having proved objectionable in handling alkali treated waters, especially in the hot process of softening, anthracite coal ("Anthrafilt") had come into favor as a filtering material—also magnetite sand. An excellent combination appeared to be "Anthrafilt" supported on a heavy magnetite under-bed. Both, however, must be free of sulphide or iron. Phosphate treated water could not be filtered through magnetite because of production of the cementing phosphates of iron.

As to coagulants—ferric sulphate and lime (pH 8.5 to 9.4) had proved most effective in removing oils and silica. In the hot process, a combination of lime-soda followed by phosphate treatment, acidification with sulphuric acid to reduce pH 9.9 to 8.9, and then final Zeolite softening, seemed to be the most effective treatment for maximum hardness and total solids reduction. The most interesting development in Zeolites had been the so-called hydrogen Zeolites, made from coal or resins treated with sulphuric acid, and also regenerated with it. Such carbon Zeolites could handle acid or alkaline water and actually liberated the carbonate and bicarbonate ions as carbon dioxide; came nearer to producing distilled water than any other scheme.

In corrosion control on piping systems and long mains, Mr. Powell cited recent installations of splash chambers under partial vacuum (27.5 to 28.5 in.) to remove all but a minor residual of dissolved oxygen, the latter being 100 per cent removed by addition of sulphite or soda. Going installations had surpassed expectations at an installation cost of $3,000 per m.g. and seemingly had an economic future. (Mr. Powell's up-to-the-minute review of progress in industrial water treatment will appear in full in a future issue of this magazine.—Ed.)

(*To be continued*)

[In the next and concluding installment will appear a digest covering papers and discussions in the Superintendents' and Chemists' Sessions.—Ed.]

(1) Walter Arnold, Public Service Supply Co., Lynn, Mass., and Mrs. Arnold; (2) Mrs. H. W. Ford, Mrs. Linn H. Enslow, Mrs. M. F. Wirtz; (3) Past President Harry U. Fuller, Chief Engr., Water District, Portland, Me., and Mrs. Fuller; (4) Mrs. Roger Esty, Mrs. Everett Howe, Mrs. Chas. Crump; (5) What were the waves saying?, when this candid shot was caught of Activated Alum's "Burt" Graham and a very charming little lady.

FILTER BED AGITATION WITH A "FILTER SWEEP"

By C. E. PALMER

Engineer, Water Department,
Erie, Pennsylvania

The Author

THE writer has for the past several years been directly interested in filter maintenance problems in the Erie Filter Plant. From the perusal of trade journals, and in a few instances from direct contact, we have been led to realize that our filter problems have been, to a greater or lesser degree, the problems of all filter plants. The chief problem is by what method or combination of methods can we keep the filter media clean and free of mud coatings, mud balls, cementations of various kinds, and the prevention of upheaved gravel beds, which result from deficient bed cleansing.

After adhering religiously to the 50 per cent bed expansion theory in filter washing for a few years [with no better success than previously obtained with a much lower wash-water rate], we were forced to consideration of the surface wash or some method of bed agitation. In a study of the surface wash idea, as used in some recent installations, the writer was of the opinion that the velocities were too low and the volumes too high to improve much on conventional back wash. Also, that the amount and sizes of piping required were too great and the installations generally cumbersome.

Development of the Filter Group

Our studies led to the development of an idea which can be most easily explained by comparing it with a lawn sprinkler working on a jet reaction principle, with design features developed to adapt it to the use intended.

From the accompanying sketch a fair idea of the simplicity of this device, together with its ease of installation and other salient features, are readily discernible. Pipe marked (1) serves as both supply pipe and support. From it descends, in a vertical manner, pipe (2) which supports a specially designed bearing at (3). To this is attached horizontal pipe (4), which is equipped with special designed slanting nozzles, spaced at proper intervals. These nozzles and assembly are so designed as to give least resistance to free movement of the revolving arm, and to produce the maximum impact velocity per pound of water pressure. For most successful operation it has been found that drive pressures should range from 80 to 100 pounds or higher. If this head is not available, it can be reasonably obtained by installing a small motor-driven booster pump in the supply line to the agitators.

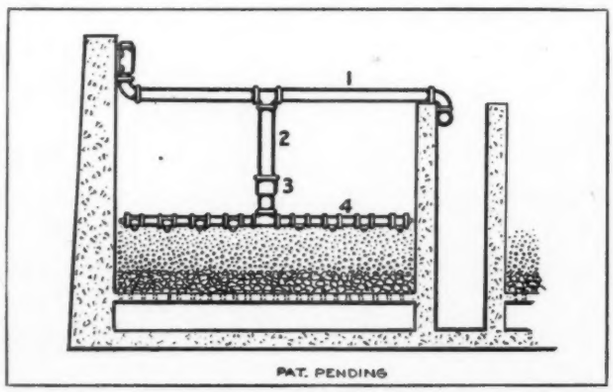
In a filter of two million gallon capacity (based on the old accepted theory of rating of 2 gallons per sq. ft. per minute), we have four of these agitators installed. They use a total of only 276 gallons per minute under 100 pounds pressure, while in full operation. Of course, the number of single agitators used in a filter depends altogether on the design or shape of the filter units; and, of necessity, installations would have to be designed with special regard to filter shapes, areas, and other features in order to give the best possible results.

Method of Adjustment

The method of use at the present time in our local plant, where experiments are still being carried out to determine if any further operating economies are possible, is to place the revolving sweep-arm about ½ inch above the filter medium as it rests in its normal position in the bed. The specially designed nozzles are set at the proper angles for the pressure supplied to the nozzles and the back wash rate to be used. It is important to co-relate these factors so that proper agitation is secured to the necessary depths, and so that the shearing action of the jets emitted from the nozzles against the filter medium, made fluid by the backwash velocity, is such that the greatest scrubbing action results.

Washing Procedure

Our present method of washing a unit calls for closing the influent valve and allowing the filter to drain down until from six inches to a foot of water remains over the bed surface. The effluent valve is then closed and the agitator started, allowing this to operate above the "dead" sand or other medium. The jets break through the heavy mat which has formed on the surface of the filter bed, and break up into small and light particles any heavy, sticky accumulations which may be present. This action is allowed to take place for from three to four minutes before the backwash is started. The backwash is then started and is controlled so that only enough rise is used to cause a slight expansion of the filter medium above the revolving arm and jets. It is sufficient to make the filter medium fluid enough to allow the arm to revolve at from five to six complete revolutions per minute. With properly designed equipment, the agitation thus created causes the otherwise bulky and heavy mud particles to be so finely ground up that they are readily removed with the comparatively low backwash velocities employed. This has caused a



Sketch of the Palmer Self-Propelling "Filter-Sweep." Developed for Filter Bed Agitation at Erie, Pa. (Numerals apply to description in textx.)

reduction in wash water consumption of from 25 to 40 per cent, while cleaning up dirty filters. Even greater savings in this item appear possible with 100 per cent clean filters.

Convincing Evidence

I will attempt to describe a very convincing happening which occurred while developing and experimenting with this agitator. The filter selected was one of 2 M.G. rated capacity, equipped with a Leopold bottom having six inches of gravel ranging in size from 5/8 inch to 10 mesh above the blocks, and into which new Cape May sand was placed in the Fall of 1935 to a depth of 27 inches. This unit is divided into two separate halves by the wash water and influent flume extending through the center. The sand at the time this experiment was started (Fall of 1937) had become heavily coated with mud to a depth of from 4 to 6 inches, and badly stained to a much greater depth. Mud balls were quite extensive throughout the whole bed. The agitator was installed in one-half of this unit, and tests and experiments were conducted to determine the best nozzle sizes and other salient features. After relatively few washes with the agitator, a very noticeable difference in the appearance of the sand was observed. This was, of course, compared with the sand from the other half of the unit, which, while it had the benefit of the same backwash, was of course minus the agitation. Within two months the sand in the half with the agitator was free of all mud, and even the stained sand grains were clean and white; whereas, the sand in the other half of this unit was as dirty and full of mud as ever.

This was a very convincing test, and to further study the possibilities of this device another filter, which was in very bad shape, was equipped throughout with the agitator. This second unit had reached a point where it would have been necessary to either remove the sand for cleaning, or cut it out of service. The sand was mud coated to a depth of from 14 to 18 inches, and heavy mud cakes were adhering to the walls and corners, at a loss of head of about 5 or 6 feet the sand would pull away from the walls. This filter was, of course, of little use. After the installation of the agitator this unit was washed once a day for about ten minutes for a period of one week before again placing it in service. The waste from these washes was continuously as black and as thick as pea soup. After placing it in service it was again washed daily regardless of loss of head for another week, after which it was placed in regular operation and washed only when the loss of head had reached 10 feet. After about three months of operation the mud was entirely removed from the surface and the mud cakes were loosened and almost entirely disintegrated. Stained sand grains were beginning to whiten and the operation was again entirely normal.

After this convincing demonstration, it was decided to equip the remaining units in our plant with the agitators. At the time of this writing ten of the sixteen units at Erie are so equipped, and all are showing remarkable results from use of these bed-scouring sweeps.

Some other very interesting results were brought to light after these installations progressed. One bed in which all new sand was placed in November, 1937, was cut out of service to install the agitators. In examining this sand the top 3/4 of an inch was found to be heavily coated with mud but the balance was quite clean, except for the fact that the whole cross-section was full of small mud balls varying in sizes from a B.B. shot to walnut size. After two weeks of normal operation and washes with the agitator, these mud balls had entirely disappeared and the sand was perfectly clean to the surface.

Other Features of Value

Another very interesting and valuable feature of the device was brought to light as a result of a short period of algae trouble that occurred at this time. As usual, with the types of algae common to our Lake Erie water, the filters plugged up quite rapidly. While the trouble was not as severe as it is in the Spring of the year, yet it was bad enough to plug a clean filter in about eight or ten hours. As most of you who have had algae to contend with will know, it is frequently next to impossible to wash all filters as rapidly as they were plugged. So, in the past, the questionable practice of bed "bumping" was resorted to. In the long run this only aggravated filter conditions by lowering the heavy mud particles down into the bed, where a large part of them remained as mud balls. With an agitator installed, it was found that all that was necessary to prolong the filter runs was to close the effluent valve and turn on the agitator for three or four minutes and return the bed to service. The action of the jets thus broke up the algae-mat and scarified the surface of the filters, exposing new surfaces, without opening any deep cracks or crevices, or allowing heavy mud particles to penetrate into the bed. The surprising thing was that the filter so treated would then run an additional 18 to 24 hours.

Experiences with Anthracite

The statements I make in the following paragraphs are based on actual observations and results, plus the writer's personal opinions:

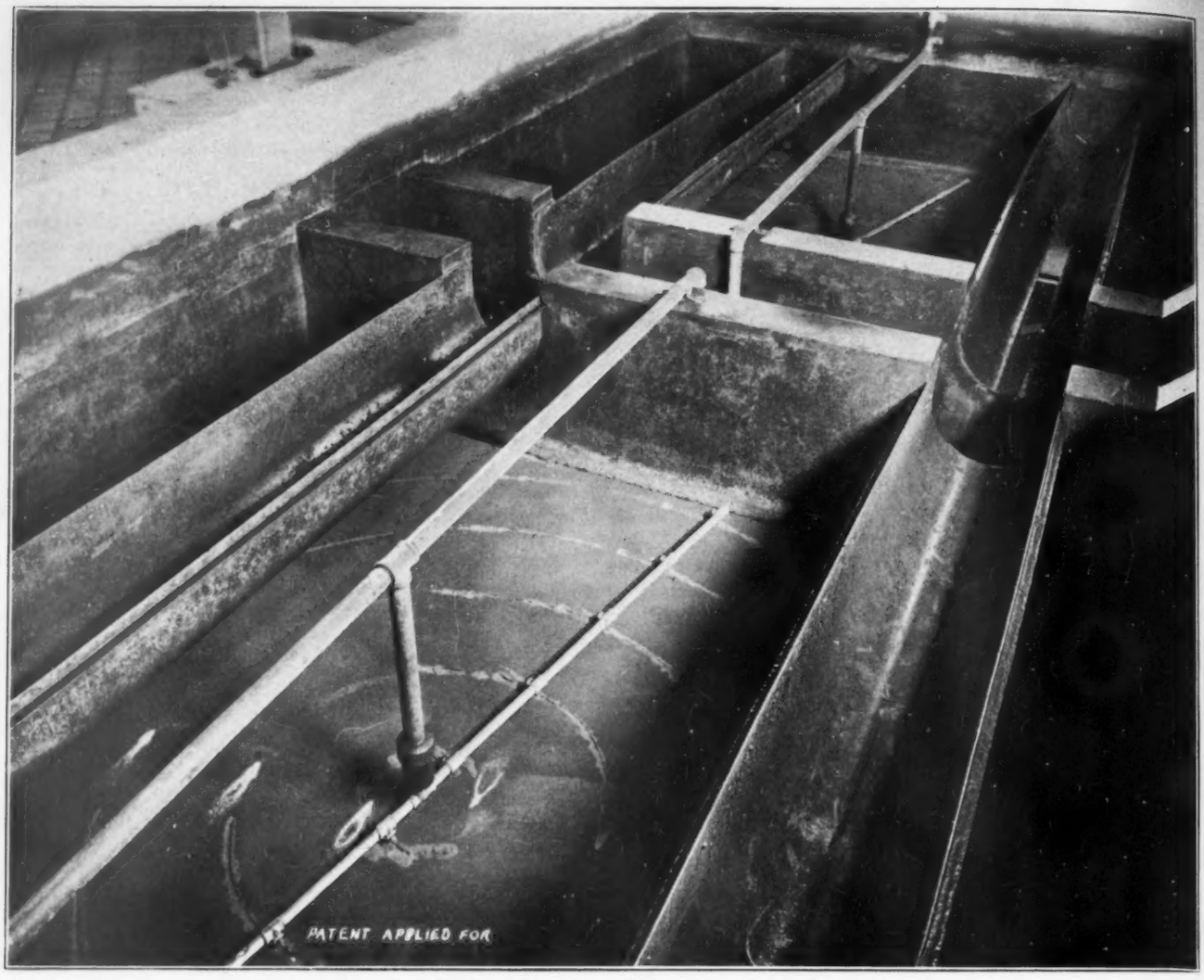
Our first experience with "Anthrafilt" as a filtering material was in the month of June, 1934, when all sand was removed from one of our units, the gravel bed reset, and Anthrafilt placed to a depth of 27½ inches. As this medium is almost 50% lighter than sand, naturally the wash water velocity required for a 50% expansion was just about half of that required for sand; which is, of course, a step in cutting wash-water consumption. More important, the length of filter runs were from 3 to 4 times as long, and no trouble was experienced during algae period from plugging. We found, however, that half our wash water velocity was not sufficient to keep mud from accumulating in the Anthrafilt bed. By increasing our wash-water velocity, we were able to keep the bed comparatively free of mud at the expense of a rather high loss of filter material. Such losses were greatly reduced by the use of a coarser particle size. In our case it was evident that some form of agitation that would permit the use of a finer Anthrafilt would be highly desirable.

There appear to be additional advantageous features with Anthrafilt as a filter medium, based on actual experience with this medium. On close examination it will be seen that the grain structure is radically different from that of a sand grain, being generally longer and thinner or more flaky—the sides being smooth and glossy. This physical characteristic makes it more resistant to mud coating and cementations, and hence much more easily cleaned. It also accounts for the longer filter runs as more of the depth of the bed is brought into service to act as a filter.

Filter-Sweep Plus Anthrafilt

With the filter-sweep, it is now possible to wash and thoroughly clean a bed of Anthrafilt without fear of losing any of the material, even of the smallest sizes. The backwash velocity can be held to a minimum and all the mud is easily removed by the use of the agitator.

The above statement is made based on extended observations with a combination sand and Anthrafilt unit. All sand had been removed from this unit for cleaning,



A View Showing the Simple Assembly of the Palmer Revolving "Filter-Sweep"—Four Units Being Installed in Each of the Sixteen 2 M.G.D. (Square) Filter Units Equipped to Date in the Erie Plant.

the gravel was reset, and the sand replaced to a depth of 21 inches. Six inches of Anthrafilt of .70 mm. size was placed on the sand. After washing with the ordinary backwash, at a velocity not high enough to wash out the Anthrafilt, a clear line of separation of the sand and Anthrafilt was caused by the hydraulic grading. This unit was then placed in service and showed many of the advantages obtained by the use of Anthrafilt. These included longer filter runs, freedom of algae clogging troubles, and reduced wash water consumption. However, all these advantages were short lived because mud rapidly accumulated between the sand and Anthrafilt, and it was impossible to remove it by the backwash process. If a velocity were used high enough to remove the mud from the surface of the sand, the Anthrafilt would be carried away with the waste water. If the velocity were held to a point where the Anthrafilt would not be lost, mud accumulated very rapidly.

All this has been changed by the installation of the agitating device. After a few washes with this device, all mud was removed from the Anthrafilt and sand, and this unit is showing some remarkable savings in operating costs. I do not hesitate to say that I firmly believe that in the future an all-Anthrafilt unit in combination with a properly designed agitating device will actually put filters on their feet, where they will give a far better account of themselves, in matters of performance and cost records, than in the past.

In Retrospect

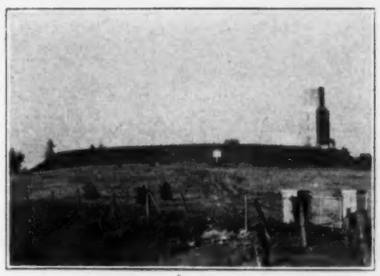
Visualize if you can the many great advantages from Anthrafilt and the bed agitator now actually proven. They are here listed briefly: longer filter runs, wash water consumption at a minimum, clean filters that *stay* clean, algae troubles practically ended, possibility of greatly increased filtration rates, improved quality of effluent, no more upset gravel beds. And, all this with the consequent saving and trouble-free operation experienced.

In this paper the writer has purposely generalized; because, to give actual figures would have consumed much more time and space. More definite statements can be given at a later date, at which time the writer will be glad to have the opportunity of presenting all of the factual data then at hand and to cover other points that have, of necessity, been omitted from this short paper.

The writer wishes to express his thanks and appreciation to Mr. J. S. Dunwoody, Gen. Supt., Erie Bureau of Water, and Mr. G. J. Papesch, Chief Operator, for their suggestions and support in the development of this agitating device.

MEETING OF VIRGINIA SECTION AT LEXINGTON ONE OF BEST

Proves Worth of Centralized Small Town Meetings



The Hill-Top "Memorial Tower" Proves to be Lexington's Interesting "Vertical Filter Plant."

WHAT proved to be one of the outstanding annual meetings of the Virginia Section of the American Water Works Association was staged August 25th and 26th in historic, cultured Lexington at the southern extremity of the famed Valley of The Shenandoah.

Work of Water—The Natural Bridge of Virginia

Historic because of her Stonewall Jackson and Robert E. Lee, who lie at peace within her boundaries; cultured because she can boast the "West Point of the South" (Virginia Military Institute) and Washington and Lee University; reputed for its equitable climate, and healthful and abundant gravity supply of "free-stone" water from the Blue Ridge; famed for her aristocracy of *real* folks; interesting to water works folks because of a novel "upstanding," and economical, filtration plant; fortunate to have Hugh Rice for Town Manager—that is Lexington, Virginia.

Abounding in surrounding scenery, the chief point of interest is the close-by Natural Bridge of Virginia—one of the natural wonders of the world, surveyed by George Washington for the King of England and turned over to Thomas Jefferson as a grant of the Crown. To Natural Bridge went members and guests of the Section for a picnic supper on the neatly cropped blue-grass lawn. Then, for a tour of the bridge and gorge to witness the impressive night "Pageant of Creation," the lighting effects of which make more awe inspiring the 17 story high sheer side-walls and massive arch of limestone over which runs the main artery of north-south travel—Lee Highway. Water works men saw one of the most famous of "works-of-water" by what, after many centuries, has now become a mere trickle of a stream. Through this famed arch shone the brilliant evening star, hanging over the western horizon to add a spiritual touch more real than the words and lighting effects, when The Voice said—"Let there be light! And, there was light."

So much for the Natural Bridge of Virginia, and for friendly Lexington. If you do not know them, go to see both. Travelling the Skyline Drive, down the very top-most spine of the Blue Ridge for miles and miles, constitutes the nearest thing that there is to air-planing with four wheels on the ground. (Note—This story is *not* paid for.—Ed.)

A Small Town Meeting

It has frequently been observed that some of the very most successful sectional meetings are those held in what may be termed the small towns. That at Lexington was an outstanding example. The type of attendance was of the highest, with operating men and man-

Hugh B. Rice, Town Mgr., Lexington, Va. (Retiring Chairman).

H. A. Johnson, Supt. Filtr., Danville, Va. (The New Chairman)

agers in the ascendancy and coming from the four corners of the State. The technical program stood out in sharp contrast to some others of recently attended and considerably larger meetings. The topics were those of interest to the small as well as the large town operators, and consequently drew attention and participating discussion from an audience not lured away by other interests. Manufacturers' representatives were there—and sat through. It was a bang-up meeting and by repute, to spread, should build the Virginia meetings and Section membership. With a registered attendance of something under 100, it was as stated, more a quality than a quantity convention, with superintendents, town managers and mayors predominating.

Officers Elected

The following were elected officers for the ensuing year:

Chairman—Howard A. Johnson, Supt. Filtration, Danville

Vice Chairman—Wm. G. Myers, City Engr., Harrisonburg

Secretary—E. W. Snidow, Va. Dept. of Health, Richmond

Treasurer—E. C. Meredith, Va. Dept. of Health, Richmond

Executive Committee—Marsden C. Smith (Richmond); Hugh B. Rice (Lexington); Roland Leveque (Fredericksburg).

Technical Sessions

Without the welcome of a mayor or other fanfare, Chairman Hugh B. Rice, Lexington's Town Manager, introduced the first speaker, **Richard Wagner,** Director of Public Works, Lynchburg, Va.

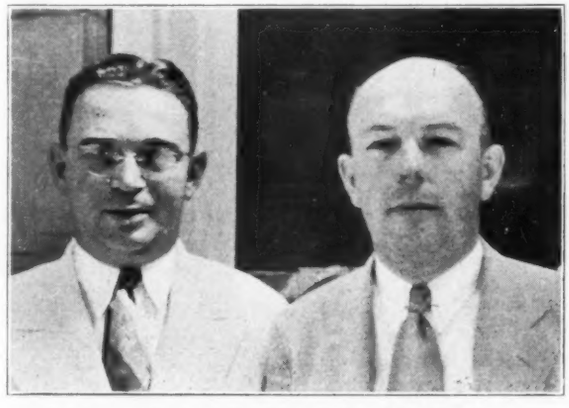
Mr. Wagner's interesting paper constituted a recounting of long experience with **"Lynchburg's Water Supply Lines—the Old and the New."** Most interesting was the exhibit (here pictured) of the bored wood log pipe, which served Lynchburg from 1800. Then, the cast-iron pipe installed in 1828 (just a little after the war of 1812) which put Lynchburg amongst the very earliest users of cast-iron pipes. Mr. Wagner, reading from the original specifications, revealed that such were 7 inch bore in 9 ft. lengths with ½ to ¾ in. wall thickness, costing them (1829) $1.15 to $1.25 per foot. He also pointed out that much of this original cast-pipe was still in use, and in excellent condition, after 110 years of continuous service. The exhibit showed such to be the case—see picture.

The next major pipe line project of Lynchburg was the 30 in. supply line from the 21 mile distant Pedlar Reservoir (completed in 1907) which was laid on a hydraulic gradient and constructed of hooped continuous redwood staves. The laying on grade was unfortunate, for in 10 years serious leakage came into evidence due to rotting staves. In checking the coefficient, instead of finding the 100 to 120 "C" value expected, such was only 85. It being apparent that replacement was becoming imminent, 9.5 miles of a new line of 36 in. light wall cast-iron pipe, produced in Lynchburg, was installed as an early (1933) P.W.A. project. In 1935 the balance of the wood stave pipe was replaced with more Lynchburg "High-Tensil" 36 in. cast-iron, as recounted in an article in the October 1937 issue of WATER WORKS AND SEWERAGE.

Hugh B. Rice, Town Manager, Lexington, Va., reported Lexington's similar experience with 14 miles of wood-stave supply line. Since 1930 it had been gradually replaced with mechanically jointed cast-iron pipes. Although the Lexington supply was very soft mountain water and corrosion and tuberculation was anticipated, "red-water" had been no problem and, after 5 years, very little tuberculation had been noted. The chief maintenance consisted of inspecting air release valves and replacements with overhauled units. In reply to questions, he stated that air seemed to be sucked into the line at some joints near the upper end. Ball and float type air release valves were being used.

R. C. Bardwell, Supt. Water Supply, C. & O. Railway, Richmond, Va., also reported failure of wood-stave pipe. In passing under railroad trackage, Mr. Bardwell stated that they had rigid specifications requiring pipe laid through tunnel, but had approved the Lynchburg scheme of using poured joints, supplemented with Dresser Joint Clamps, to preclude joint blowing or seepage through poured joints. Mr. Wagner added that these clamps had likewise been used on all submerged river and stream crossings.

Questioned as to why the new cast-iron line had not been lined, Mr. Wagner stated that lining had been considered until inspections showed no tuberculation of a Venturi Meter after 7 years' service. Mr. Enslow stated that, although theoretically the Lynchburg and the Lexington waters should be corrosive, it was apparent that organic matter buffered the water sufficiently and actually laid down a film on the pipe walls. If the filtration plants of these towns had been on the reservoir end of the lines, probably a different story would be written, unless adequate corrective anti-corrosion treatment of the water was being assured.



Presidents of A. W. W. A.

Virginia's "Gene" Dugger (Immediate Past Pres.) and New York's Reeves Newsom (President).

Programmers

S. L. Grant, Supt. Water, Winchester
Richard Wagner, Dir. Public Wks., Lynchburg
Roland Leveque, Supt. Filtration, Fredericksburg

Distribution System Leakage—Surveys and Records

A. M. Field, City Manager, Winchester, Va., scheduled to open discussion on this important topic, was unable to be present. His paper, read by **S. L. Grant,** Supt. of Water, Winchester, presented Winchester experiences of pumpage increase year by year without corresponding increase in customer revenues. In 1935 a pitometer survey revealed a loss of 242 million gallons annually out of the 615 million pumped. Leak locations and repairs reduced the pumpage unaccounted for to 104 million, resulting in 80 per cent being accounted for. However, by late 1937 that figure had gradually dropped to 71 per cent, but during the two years the pumping bill had been reduced from $8,200 to $6,000 per year while the revenue increase had been $5,000. Mr. Field described the zone method of making leakage surveys through by-pass metering or Pitometer records. Also, the more recent use of a radio type leak locator set up on fire-hydrants. At present their chief concern was with small service line leakage, now being corrected by replacement of corroded services with copper-tubing pulled through with a pipe-pusher operated in reverse.

I. G. Vass, City Manager, Waynesboro, Va., recounting a recent experience of serious water loss through a hidden leak, resulting from a blown joint on an old 6 inch line to an abandoned industrial plant, stated that after 10 years of repeated recommendation his council had voted the making of a systematic leakage survey. Further than that it had voted to apply for a P.W.A. grant for complete meterization at the same time. At present, with only commercial and industrial consumers (4 per cent of the pumpage) metered, the question "What cost leakage in Waynesboro?" could not be answered. The need of the survey was indicated when the above major leak was run down only after much searching and inspection of sewer manholes. Even considering the over abundant spring supply of 3 m.g.d., and present pumpage of but 1.5 m.g.d. at the attractive cost of 13 mills per 1,000 gals., Mr. Vass considered it good business to tighten up the system and stop water-waste by metering. He felt that, considering the 16 miles of 3 in. C. I. pipe in the system, improved service would be one result and the money saved might be used for distribution betterments.

Bristol's Experience Outstanding

P. A. Goodwyn, City Manager, Bristol, Va., reviewed a recent experience in leak detection of which there is probably no parallel. For some time it had been realized through Pitometer survey that important leakage existed on the supply line bringing in expensively softened water. In addition, there is known to exist one or more leaks on a certain section of the distribution system—but, just where? Cavernous limestone formation and depth of the main had defied fixing the exact location of the leaks.

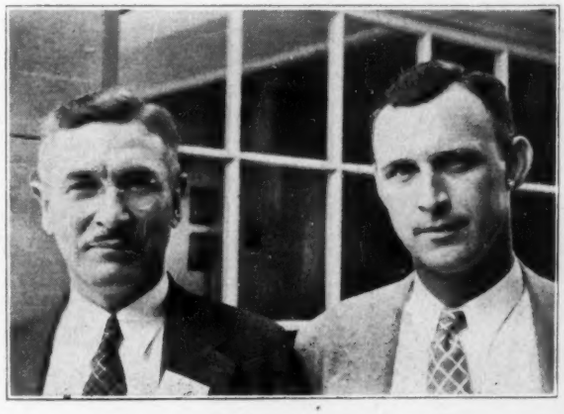
Due to lack of effective meterage, Bristol, Va., was consuming (losing or wasting) at the rate of 278 gals./capita/day. In comparison, the Tennessee side of the city (the center line of Bristol's Main Street being the Va.-Tenn. State line) being 100 per cent metered, experienced a normal expected consumption of but 87 gals./capita/day and collected for most of that. So much for the value of metering as revealed in a city "divided against itself."

As to these baffling major leaks, one day a representative of the Water Leak Detector Co. of Columbus, Ohio, asked to be allowed to demonstrate an instrument which might successfully locate Bristol's leaks. Based on delicate vibration tuning, his instruments connected to fire hydrants proved successful in locating about the exact spot of the deep leak on the distribution system which had been worrying us. Said Mr. Goodwyn, "It was not as easy as it sounds to tell about, but it was a success. This leak proved to be 100,000 gals./day—we were elated. Then the next job was to locate the other leak on the supply line. This proved a simpler job with the instrument, and again was located another 100,000 gal./day leak."

The results of stopping these leaks have been significant. Water pressures during peak consumption increased from 55 lbs. to 70 lbs., resulting in better service on high spots and better fire protection. An old source of supply on the opposite side of town from the main supply of softened water has been discontinued. Naturally, the reduced cost of softening and reduced loading on the plant is worthy of comment. (Bristol's recent experiences have forced more attention on the worth of systematic modern leakage surveys, and effective meterization, than any picture which has appeared in recent times. More is to be heard about this in an article by Mr. Goodwyn to appear in an early issue.—Ed.)

"What About Leaks on Consumers' Services?" was a question propounded from the floor for discussion.

D. R. Taylor, Supt. Water Department, Roanoke, Va., stated their very satisfactory experiences with use



"Re-Elected"

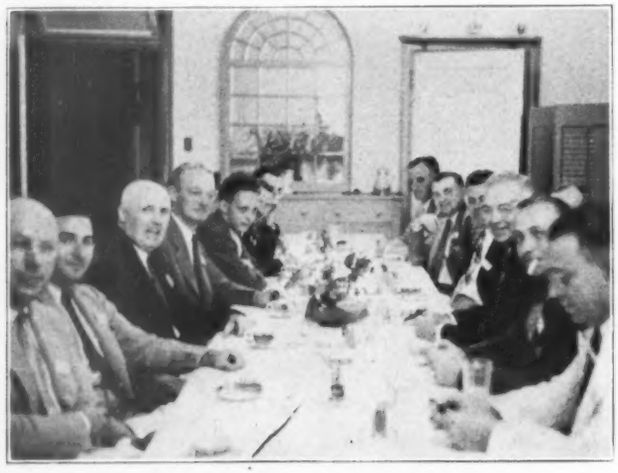
Secretary—H. W. Snidow; Treasurer E. C. Meredith (Both work for Major Messer, Virginia's Chief Sanitary Engr.)

of a Neptune recording meter, placed on services as the result of complaints from high bills. The record chart telling the history of water use for a day in the customer's home, plus the leakage and waste during non-water use hours, had proved the finest method yet found for convincing the customer where the trouble lay. Said "Doc" Taylor, "we tell him what time he got up; when he shaved, how much water ran while the hot water was coming up, when the dishes were washed, how many times the toilet was used during the night, morning and forenoon; we tell him how much water was used for every operation, how much was leaking somewhere. By the time we get up to the afternoon on that chart the successful method of persuading the customer that his meter isn't lying and that he can save money by getting after his leaks." (Instruments of this nature have come to be known as the "Water Works G. Men" of which Roger Esty has written in our September issue, relating other advantageous uses in addition.—Ed.) Mr. Taylor also told of a method of placing a match-stick on the meter hand, after all interior fixtures had been shut off, and having the customer watch the hand move from under the match. However, nothing could approach the effectiveness of the charted record which unraveled its story in a baffling style.

Geo. Spratley, Manager, Old Dominion Water Company, Hopewell, Va., reported much misery from leaking consumer services of galvanized pipe. As to locating leaks in the home, his procedure was to ask permission to inspect fixtures personally. In 99 per cent of the cases the trouble could be spotted in the bathroom, by one or another method. One of the most baffling was where a straw from a whiskbroom would lodge under the ball valve. On the next flush it would move out but then worked back again. Just by luck he had caught the trouble.

"What is the policy of adjusting bills for water loss unknown to the customer?" was another question by Blackburg's long time and inquisitive Mayor—Dr. F. W. Eheart.

D. R. Taylor stated that Roanoke had gone halfway to help out the customer by making a 50 per cent rebate on the excess portion of the bill. However, on the next bill there was no rebate—accident or not. For 10 years this 50/50 settlement has proved a successful scheme. Things to remember in settling complaints of water bills: (1) don't be too hard boiled; (2) never be a "sissy"; (3) treat everybody alike.



Brass-Hats and Honored Visitors

Luncheon Guests of Chairman Rice and City of Lexington.

A. L. Meisel, Town Manager, Williamsburg, Va., said that high meter readings were promptly reported by the reader. To put the Water Department on the offensive, rather than defensive, the cause was investigated and the consumer notified before the bill delivery.

The President Introduced

At this point Reeves J. Newsom, President of A.W.W.A., was introduced. He reviewed the activities (present and planned) of A.W.W.A. in which participation of individual Sections was to play a more important part in technical committee work, through establishment of energizing local committees. The major problem was that of getting members to assume a more active part on the programs and in the work of A.W.W.A. It was desirable that more discussion be given in Section meetings to proposed specifications while in their formative stage, and before presentation at National conventions.

President Newsom gave the Virginia meeting a deserved word of commendation on attendance, set up of program, and general tenor of the meeting. To him it was an added proof of the value of small homogeneous meetings and individual State sections.

Services—Kind of Pipe, Water Location, Etc.

Geo. L. Spratley, Manager, Old Dominion Water Corp., Hopewell, Va., suffering with service trouble due to playing out galvanized lines, revealed their life in Hopewell at 15 years—possibly 20 years. Copper tubing was now being used in replacement and in all new work. He couldn't see the use of red-brass pipe and elbows, since the less rigid tubing had become available. Concerning meters: the curb location was preferable in the equitable climate of Hopewell; boxes large enough, with meters set in risers, was his choice over use of yokes. So-called battery-meters (3 or more 1-in. disc. meters in tandem settings) were preferred to larger compound meters, which had proved less accurate for markedly fluctuating flows and also productive of high friction loss.

R. L. Blankenship, Town Manager, Orange, Va., said that for meter setting they had found the Ford "Copper-horn" to have distinctive advantages. Since having difficulties with bursting of lead goosenecks, copper tubing had been standardized on in sizes no less than 5/8 inch, and curb cocks of same opening.

D. R. Taylor pointed out that copper tubing might be one thing or another. For water works services Type "K" tubing (covered by U. S. Government Specifications), consisting of better than 99 per cent pure copper, should always be demanded.

Should Plumbing Installations Be Approved by the Water Department?

Eugene F. Dugger, Manager, Water Works Commission, Newport News, Va. (immediate past president A.W.W.A.), introduced this topic of growing importance to water works managers. After reviewing recent published findings as to existing hazards from inferior interior plumbing equipment, and potential dangers of contamination due to back syphonage, Mr. Dugger dwelt on the use of undersized and inferior piping as a source

About Sixty Per cent of Those Attending the Lexington Meeting of the Virginia Section.

of difficulty. Corroded and choked service lines or interior piping brought criticism on water utility service. He, therefore, felt that water works managers should have more to say about interior and consumer service piping. Water works managers should themselves undertake the working out of practical ways and means of such attainment. He felt that eliminating sanitary hazards, cross connections, and the like, should reside in the Health Department and come under a competent sanitary engineer whose salary might well be derived from the Water Department, Public Service Department, and Health Department, jointly.

Seth Burnley, City Manager, Charlottesville, Va., spoke briefly concerning the recently enacted Virginia legislation, setting up a plumbing code. Therein had been incorporated regulations of toilet flush valve installations and all cross-connections hazardous to public water supply prohibited. To enforce the code no state machinery or funds had been provided. It was mandatory, however, that all cities of the first class adopt and enforce the new code within the period stipulated.

C. E. Moore, General Manager, Water Department, Roanoke, Va., a scheduled discussor, sent in a written contribution. It was Mr. Moore's opinion that Water Departments should not be burdened with the responsibility of regulating interior plumbing. However, the right of disapproval should be given the Water Department of all plans and specifications passed by the regulating agency (building and plumbing inspector's office) should be made subject to review by the Water Department and Health Department. D. R. Taylor added that there should be a distinction between health hazard and dependable and adequate piping facilities, to insure water service of like qualities.

A. T. Lundberg, Chief Engr., Water and Sewerage, Arlington County, Va., stated that Arlington County had a plumbing code involving well defined responsibilities of the Water Department through the fixtures, and jurisdiction of the Plumbing Department started where the Water Dept. left off.

Wm. G. Myers, City Engr., Harrisonburg, Va., reported that the Water Department of Harrisonburg now has jurisdiction over all interior plumbing going into new or revamped buildings. All old plumbing and hazards remained the problem of the Health Department.

L. H. Enslow, Editor, "Water Works and Sewerage," asked for his opinion, said that from all that he could learn of the hazard question from disapproved plumbing fixtures most of the "hullaballoo" was not justified. What would be a potentially hazardous fixture on one piping system would not be on a piping system which could be considered of proper materials and pipe sizes. The danger could not be what "head-line-hunters" had pictured it to be. If so (a question properly raised by many), Why aren't we all long since dead? Now, it is agreed, that every fixture has its hazard factor, but that factor depended upon the basic question—What condition the interior piping? Certainly for the good name of the water utility the right of approving or disapproving private service lines and interior piping specifications should be that of the Water Utility. If, in all cases, the piping from main to roof is of the proper size and of materials which local water quality dictates, satisfactory water quality and pressures in the building will be assured and preclude consumer complaints. Then, the potential vacuum hazard fades to insignificant proportions and, with it, so the hazard-factor of most fixtures now classified as disapproved. What should be disapproved is one piping system—not 100 fixtures.

Reeves J. Newsom, Consulting Engineer, New York City (President of A.W.W.A.), said that there was much to what Mr. Enslow had said. He spoke of the participation of A.W.W.A. in cooperative efforts of several interested organizations looking to development of the Standard Plumbing Code, including materials and minimum size of piping.

Speakers

Seth Burnley, City Mgr., Charlottesville
F. W. Eheart, Mayor, Blacksburg
(Waging a campaign for soft water)
A. L. Meisel, City Mgr., Williamsburg
(Rockefeller rebuilt it; Meisel runs it)

(1) *R. L. Blankenship (Town Mgr.) and W. E. Knighton (Plant Supt.) Orange, Va.;* (2) *Wm. G. Myers (City Engr.) Harrisonburg, Va., and E. J. Canton, Badger Meter Co.;* (3) *J. M. Pharr (Chemist) and W. B. Harman (Ass't Mgr. Water Wks.) Newport News, Va.;* (4) *W. C. McBryde, Johns-Manville Co., and A. M. Elder, Worthington-Gamon Meter Co.;* (5) *W. J. Edwards (Water Comm.) and C. J. Bruce* (Supt.) Evetts Creek Water Co., Cumberland, Md.*
**President Md.-Delaware Water & Sewage Wks. Assn., and Vice-Pres., Penna. Water Operators Assn.*

Mr. Dugger commented that adequate design of piping would not take care of vacuum from main breaks. To preclude such, check valves might be required on each service line. (Mr. Dugger failed to consider that in a main break everything that would be pulled in flows to the break and mostly out through it. In resuming service the water is so objectionable in appearance that flushing and much wasting is resorted to.—Ed.)

"Kinks for the Super"

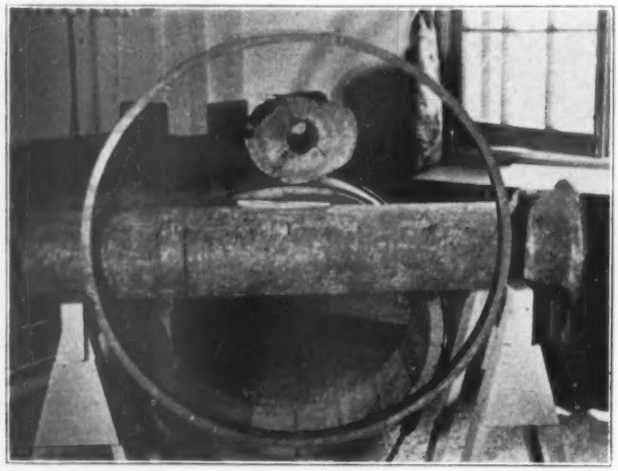
"Water Works Operating Kinks" appeared on the program as another contribution from Roanoke's new Water Department, until recently Roanoke Water Co., "Doc" Taylor, Superintendent (then and now), opened up a whole "bag of kinks," of never ceasing interest and value to operating men.

Exhibit No. 1—An extractor, with biting left handed threads and square head, for removing broken off corporation cock ends and nipples. Cost—35c; savings—plenty.

Exhibit No. 2—Threaded plugs, with gasket, for stopping holes in pipes, tanks, etc. The plug screwed in cuts its own hole and threads; does a splendid job.

Exhibit No. 3—The Roanoke "bulldog," for pulling copper tubing through bored holes or after old services. It is a home-designed expansion plug inserted in the tubing end and expanded. The tougher the pull, the more the expansion; can be coupled to pipe or hooked to a cable.

Exhibit No. 4—"Rapid Pipe Extension Estimate Chart." Everything required in the way of cost per foot appears on Taylor's ready reference chart for estimating, in a few minutes, total cost of laying ½ to 20 inch pipe at present market and labor costs, under variety of ground and paving conditions, including linings, fittings, valves, etc. (The chart and description of its use constitutes a contribution by Mr. Taylor, to appear in this or the next issue of WATER WORKS AND SEWERAGE.—Ed.)



More Than a Century of Lynchburg's Pipes

From bored logs (1800), *to 9 ft. lengths of 7 in. imported cast iron in* 1828; *from 30 in. wood-stave supply line* (1907) *to 36 in. "High-Tensile" cast iron in* 1936. *Still in service is some of the* 110 *year old C. I. pipe, bought by the foot in those days.*

Exhibit No. 5—Meter-Shop money-saving tricks. One make of meter used has discs larger than another make. Worn discs of the smaller are replaced with worn dics of the larger, the latter being machined down to fit. Net saving 54 cents per disc, reclaimed thus for 300 to 400 meters. Another trick involved a similar reclamation of split disc-balls.

Overhauled compound meters usually show money-losing leakage around the cage. To stop such, roofing cement is used in the assembling of the cage. In all meters repaired for hot water damage graphite discs are inserted. In meter-tests an accurate rate of flow indicator is used—consists of a glass tube "Rotameter," accurate from 1/100th to 30 g.p.m. Some modern meters (new) are found to rotate on 1/100th g.p.m. flow. Incidentally, routine testing of household meters had been extended to every 7th year, with a net saving shown. Meters 1½ inch and larger are checked monthly.

Main Emptying—Compressed air, reported Mr. Taylor had been used with considerable success for completely emptying mains before cutting for repairs, etc. The scheme involved connecting an air compressor to one hydrant and blowing out through another. In 3 to 16 minutes the job was completed and not more than a gallon of water was spilled in the trench when the cut was made. An off-and-on scheme seemed best with the air, the main being completely emptied with the third air-blast. The largest main so emptied had been 12 inch size. (For the detailed method see Reference & Data Section of April 1938 issue.)

Paint for Wet Pipes—At long last a paint (name on request) had been discovered which could be applied to sweating pipes, tanks, etc., and would stick on. Further, it was not an expensive paint either.

Root-Proof Joints—On terra cotta lines "Leadite" joints had effectively prevented roots entering the line.

Water Quality Problems

H. E. Lordley, Supt. Filtration, Richmond, Va., leading in the discussions of "Problems in Water Quality" referred to the valuable paper by Dr. Sidney Negus (Journal A.W.W.A., Feb., 1938) as the best available published discussion of the significance and tolerances of various compounds in potable waters. This paper would stand water works operators in good stead when combatting accusations that copper, chlorine, alum and the like are deleterious to the human system. He compared the effects of natural pollution of streams as an insignificant problem as compared to industrial pollution. In discussing corrosion control and prevention

(1) Henry Salomon, L. A. Salomon & Sons, New York, and J.P. Hurd (Treas.) Blacksburg, Va.; (2) "J. E. Carper and Son"—the dad being Ass't Supt. Water at Salem, Va., the son (W. H.) being City Engr. of Fredericksburgh, Va.; (3) F. C. Taylor, who sells Pittsburgh Meters, and F. G. Swaffield, Distr. Mgr., Pittsburgh-Equitable Meter Co.; (4) W. H. Fawcett, City Engr., Bristol, Va., and Chas. Gregg, Distr. Mgr., S. R. Dresser Mfg. Co.; (5) E. J. G. Wilson, Wiley & Wilson Engrs., Lynchburg, Va., and John T. Woodson, Mgr. Sales, Lynchburg Foundry Co.

of putrefaction in dead ends, as two of the chief problems in quality control, he outlined methods of determining the proper degree of water hardening with lime and pH control. In the important matter of controlling water quality degredation and complaints from outlying sections of the distribution system, he cited the continuing success of "chloramination" to maintain sterile mains. But, he warned that an excess of ammonia would result in fertilization and speeded growths in reservoirs, and to a lesser extent in mains, should the residual chlorine disappear.

In Richmond the importance of "Keeping good water good" in the distribution system had been so well demonstrated as to justify systematic sampling and testing of water from 50 stations for pH, odor, iron, residual chlorine, color and turbidity. The results served as the guide in programming flushing operations by one man devoting his entire time to this duty. This man flushes 75 dead ends weekly in summer, reporting appearance, odor and flow rate of flush with hydrant full open.

Roland J. Leveque, Supt. of Filtration, Fredericksburg, Va., commented on the value of routine testing for residual alumina in coagulation control, supplementing the jar test which alone he had not always found sufficient in operating the Fredericksburg plant now handling an overload of 20 to 60 per cent until enlargement under way could be completed. In introducing ammonia-chlorine treatment, soon to be started, he wondered what effect the residual chloramine might have on soft-drink bottling works. In replies from the floor, there seemed to have been no troubles reported at Danville, where bottling works are located near the plant, nor at Richmond.

H. A. Johnson, Supt. Filtration, Danville, Va., felt that it was to every purification man's interest to follow the water through to the consumer's taps and not rest on his oars too much, based on water quality as he turned it into reservoir or distribution system. In an open reservoir "Chloramination" had one weakness. Having corrected the bacterial aftergrowth problem and improved that record on the distribution system, the ammonia had fertilized algae-growth in the open reservoir, requiring copper sulphate treatments every 10 days in algae season. No microscope was needed to determine when to copper. When the chlorine residual dropped to 0.05 p.p.m. that had proved the signal to apply copper.

A. E. Griffin, Chemist, Wallace and Tiernan Co., commenting on the effect of residual chlorine on food products, stated that high residuals without ammonia had been complained of in beer production, but there had been no parallel with chloramine residuals. Concerning algae, some of the cocus types had been found growing in the presence of as much as 0.4 residual chlorine where ammonia was not being used.

Speakers

Sterling Williamson, City Engr., Charlottesville, Va.
(Past Chairman of the Section)
Geo. Spratley, Mgr., Old Dominion Water Co., Hopewell, Va.
(Broom-Straw Detective)
P. A. Goodwyn, City Mgr., Bristol, Va.
(With a radio leak-detector saved Bristol much.)

Bryan L. Strother, Supt. Filtration, DuPont Co., Hemphill, Richmond, Va., handling James River water below Richmond, said that natural ammonia from human sources in the river stood them in good stead. It was only necessary to supplement the natural ammonia periodically. When such was not done they soon learned that slime growth appeared in the plant piping system to cause manufacturing troubles.

Corrosion Problems

R. C. Bardwell, Supt. of Water Supplies, C. & O. Railway, Richmond, Va., in discussing "Corrosion and

(1) John McKague, National Meter Co., Brooklyn, N. Y., and Ralph L. Kelly, Hydraulic Development Corp., New York; (2) "Bob" Clement, Wallace & Tiernan Co., and Mrs. "Bob"; (3) These W. & T. boys will gang up on us. Here's "Jerry" Cavanaugh and "Shorty" Griffin in a little side-walk discussion on "Chlora mination" (or something) which appears to be interesting; (4) R. C. Bardwell, who has charge of water supply for the "Iron Horses" of the C. & O. Ry. System, and Mrs. Bardwell of Richmond; (5) From Arlington County, Va., there was R. C. Beard of the Water Dept., and A. T. Lundberg, Engr. of Water and mond; (5) From Arlington County, Va., there was R. C. Beard of the Water Dept., and A. T. Lundberg, Engr. of Water and Sewers.

(1) E. E. Barnard, Lynchburg Consulting Engr.; (2) C. S. Steele, Chief Operator Lexington Filter Plant; (3) R. L. Ranalds, Town Mgr., Luray, Va.; (4) E. R. Sharp, Ass't Engr. of Henrico County, Richmond, Va.; (5) Tom M. Bost, Jr., Lynchburg Foundry Co., Lynchburg, Va.; (6) B. L. Strother, Supt. Filtr., DuPont Co., Richmond, Va.; (7) J. W. Phelps, Pres. Phelps Water Co., Roanoke, Va.; (8) "Mike" Siebert, Distr. Mgr., Neptune Meter Co.; (9) Ed. H. Ruehl, Field Consultant, Va. League of Municipalities, Richmond, Va.

its Control," stated that "as a rule, the more speeches and published articles on a subject, the less is actually known about the matter." The proof of that contention seems rather well illustrated in corrosion control. After discussing the theory and general considerations to follow in corrosion control, Mr. Bardwell pointed out that for potable waters the most practical procedure was to reduce free carbon-dioxide by aeration and raise the alkalinity (pH value) with lime or caustic soda or some of each. In industrial water treatment, dissolved oxygen removal along with CO_2 removal was to be considered

"A Natural"

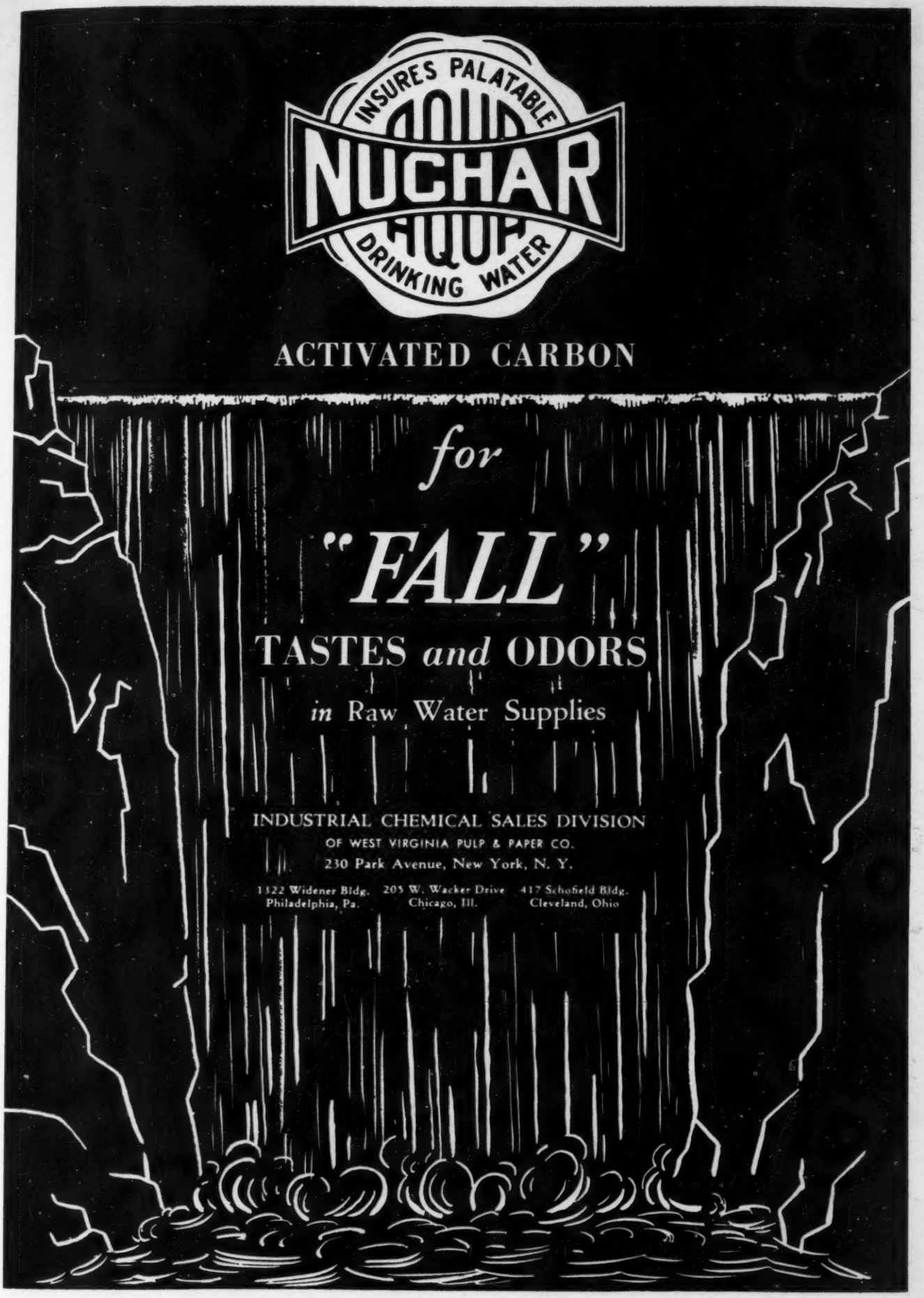
The Mayor, A. L. Bolick, of Luray, Va.
The Mfgr., Clinton Inglee, of New York
(President of the Water Works Mfgr. Assn.)
The Engr., Wm. M. Johnson, of Lynchburg, Va.
(His firm—Wiley and Wilson—threw away the books, gave Lexington something new in filter plant design.)

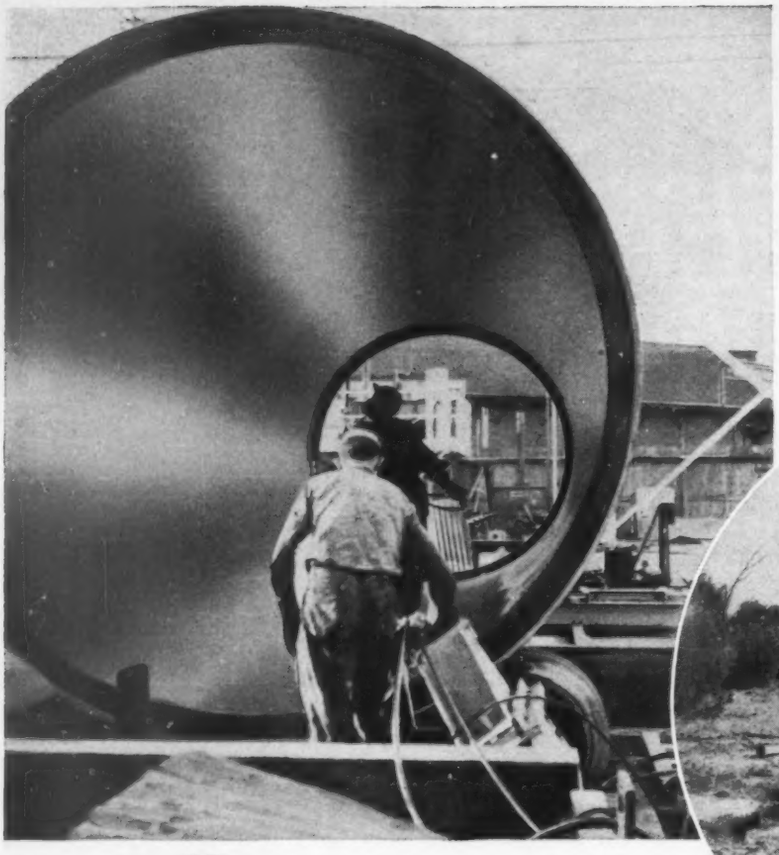
in addition. For the purpose vacuum aerating towers were employed. The most dependable foundation for corrosion and tuberculation control remained that of treatment to cause plating out of protective film-coating from the treated water. To this end the use of lime and silicates (alone or in combination) had proved the most practical solution.

Mr. Bardwell discussed methods for determining when treatment was of an order to produce such coatings. Herein determinations of the Langelier Index was the most scientific method, but for ordinary routine control on changing waters the simple marble test as published by McLaughlin had proved more practical. (See Reference & Data Issue of this magazine, April 1938, page 422, for the procedure.) In some instances the treated water caused a too heavy deposition of calcium carbonate near the point of treatment and none was left for the distant points. To retard the rapid deposit rate additions of sodium hexameta-phosphate to the extent of 10 lbs. per million gals. had been found helpful in hot water systems. Concerning the cause and control of caustic embrittlement of steam boilers the addition of sulphates to maintain a defined CO_3: SO_4 ratio had not been as reliable a remedy as at first thought. Now the addition of lignous products seems to have promise. On the C. & O. Ry. system they were using lignous waste liquors from paper pulp production.

L. H. Enslow in commenting on the Langelier Index and the marble test (which should give the same answer for all practical purposes), referred to the practicability of setting up limestone contact units for continuous operation and revelation of the sufficiency of corrective treatment. In short, the scheme would reveal at any minute the Langelier Index and would serve as a continuous marble test. On the board, Mr. Enslow sketched 2 in. glass tubes (could be copper) kept filled with finely crushed marble or limestone such as is sold as chicken grit. Continuously into the bottom flowed the treated water and out at the top. By taking samples at the bottom and of the outflow the titration and pH values would indicate (by difference) the corrosion or depositing index of the treated water. What would have to be worked out was the minimum contact period required between the water and the limestone or marble. Such might require more than one tube of limestone connected in series. The first (up-flow) tube might contain very finely divided carbonate such as chalk; the second the grit size particles to intercept any suspended chalk which might be carried over from the first tube. With such a continuously running hook-up, samples taken by an operator capable of making a pH test or titrations will reveal the need for increased or lowered treatment, with changes in water quality.

(1) The New Chairman, H. A. Johnson, and Lexington's Thelma Childress and Jem Mahanes, who handled the registration desk; (2) R. H. Spessard, Engr., H. C. Jones, Chief Filter Operator and I. H. McMann, Engr., Riverside and Dan River Mills, Danville, Va.; (3) "Dick" Ford (Ford Meter Box Co.) learns from R. L. Blankenship (Orange, Va.'s, Manager) of a new use for "Copper-Horns"; (4) "Nuchar's" Smiling "Bob" Haywood, Phipps and Bird's "Pat" Gaskins, Marsden Smith's H. E. Lordley, Supt. of Filtration at Richmond; (5) D. R. Taylor, Supt. Water Wks., Roanoke, Va., and the Fred Stuarts of Activated Alum Corp., Baltimore.


INSURES PALATABLE
NUCHAR
DRINKING WATER
ACTIVATED CARBON
for
"FALL"
TASTES and ODORS
in Raw Water Supplies
INDUSTRIAL CHEMICAL SALES DIVISION
OF WEST VIRGINIA PULP & PAPER CO.
230 Park Avenue, New York, N. Y.
1322 Widener Bldg. Philadelphia, Pa.
205 W. Wacker Drive Chicago, Ill.
417 Schofield Bldg. Cleveland, Ohio



DEPENDABLE PROTECTION

Reilly PIPE ENAMEL and PRIMER

SAFEGUARD YOUR INVESTMENT....

DEPENDABLE PROTECTION of water pipe lines and conduits against rust, corrosion, tuberculation and other destructive agents is assured when all metal surfaces, *inside and out*, are coated with REILLY PIPE ENAMEL and PRIMER. These thoroughly tested and proved coatings form a permanent bond to the metal, are abrasion resistant and safely withstand a wide range of temperature changes. Will not crack or peel at temperatures as low as minus 20°—nor flow or sag at temperatures approaching 200° F. Easily applied by centrifugal spinning, rolling rig, or hand daubing.

Reilly COAL TAR PRODUCTS

REILLY TAR & CHEMICAL CORPORATION

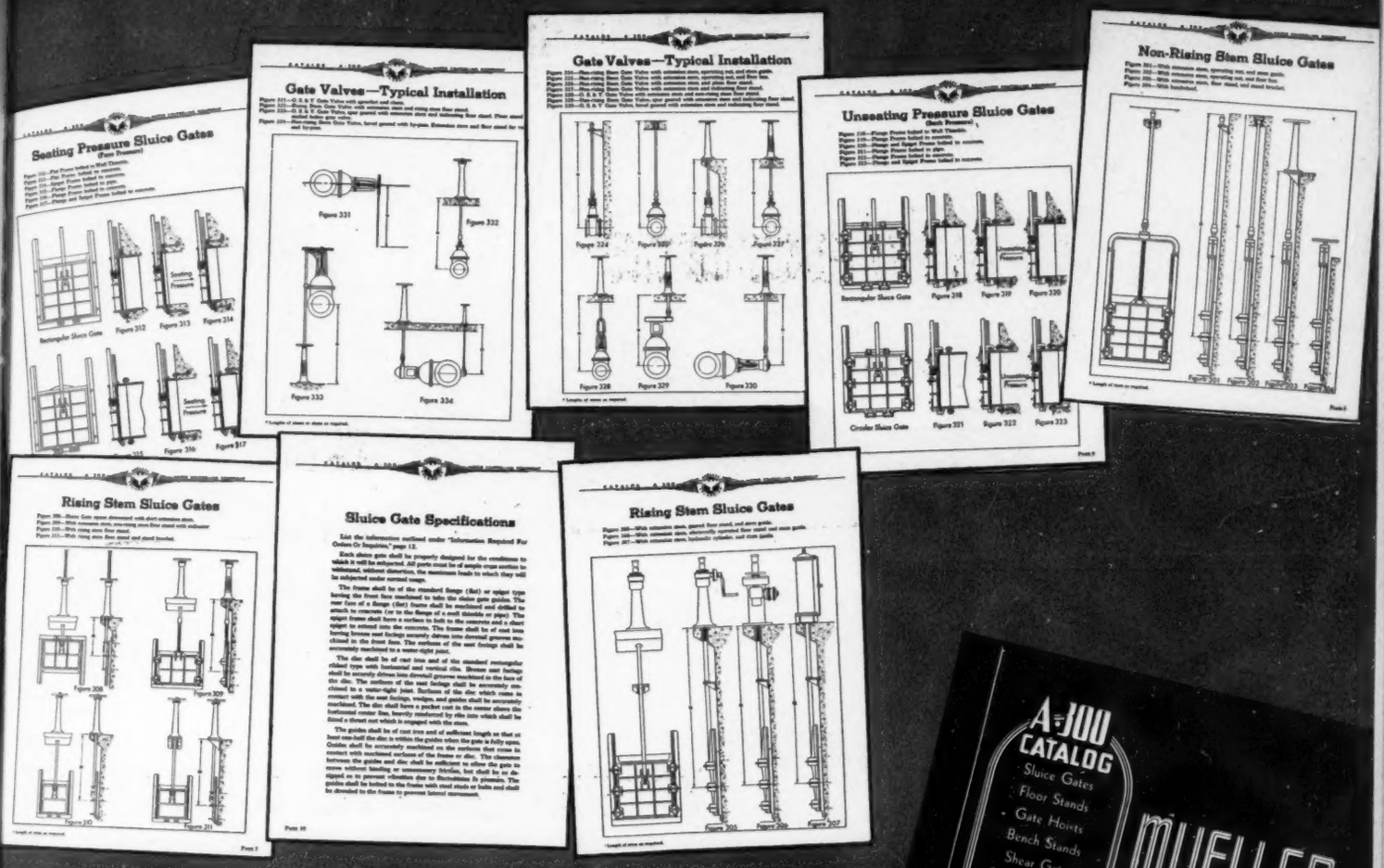
Executive Offices: Merchants Bank Building, Indianapolis, Indiana

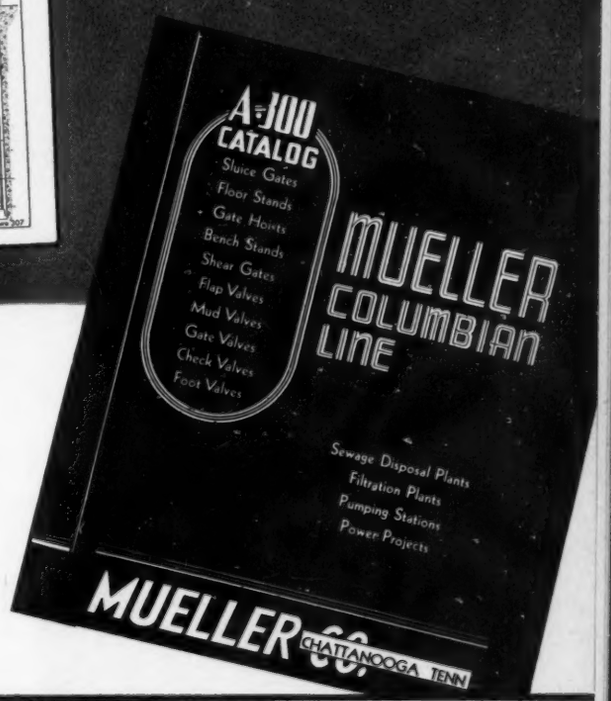
2513 S. Damen Avenue, Chicago, Illinois • 500 Fifth Avenue, New York, N. Y. • St. Louis Park, Minneapolis, Minn.

15 CONVENIENT PLANTS TO SERVE YOU

SLUICE GATE & GATE VALVE

TYPICAL INSTALLATIONS





Not only does the Mueller A-300 Catalog show the complete line of standard sewage disposal equipment, but it also shows many typical installations of Sluice Gates and Gate Valves. This information has saved many a dollar on water controlling projects because it has permitted engineers and designers to use the knowledge of Mueller engineers and to plan their projects around standard equipment, often eliminating special equipment.

This combined catalog and hand-book of information should be in the hands of everyone interested in water controlling projects. If you haven't your copy, tear off the attached coupon and mail it in today.

MUELLER CO.

CHATTANOOGA, TENN.

Mueller Co., Dept. WS 1038
Chattanooga, Tenn.

Gentlemen:

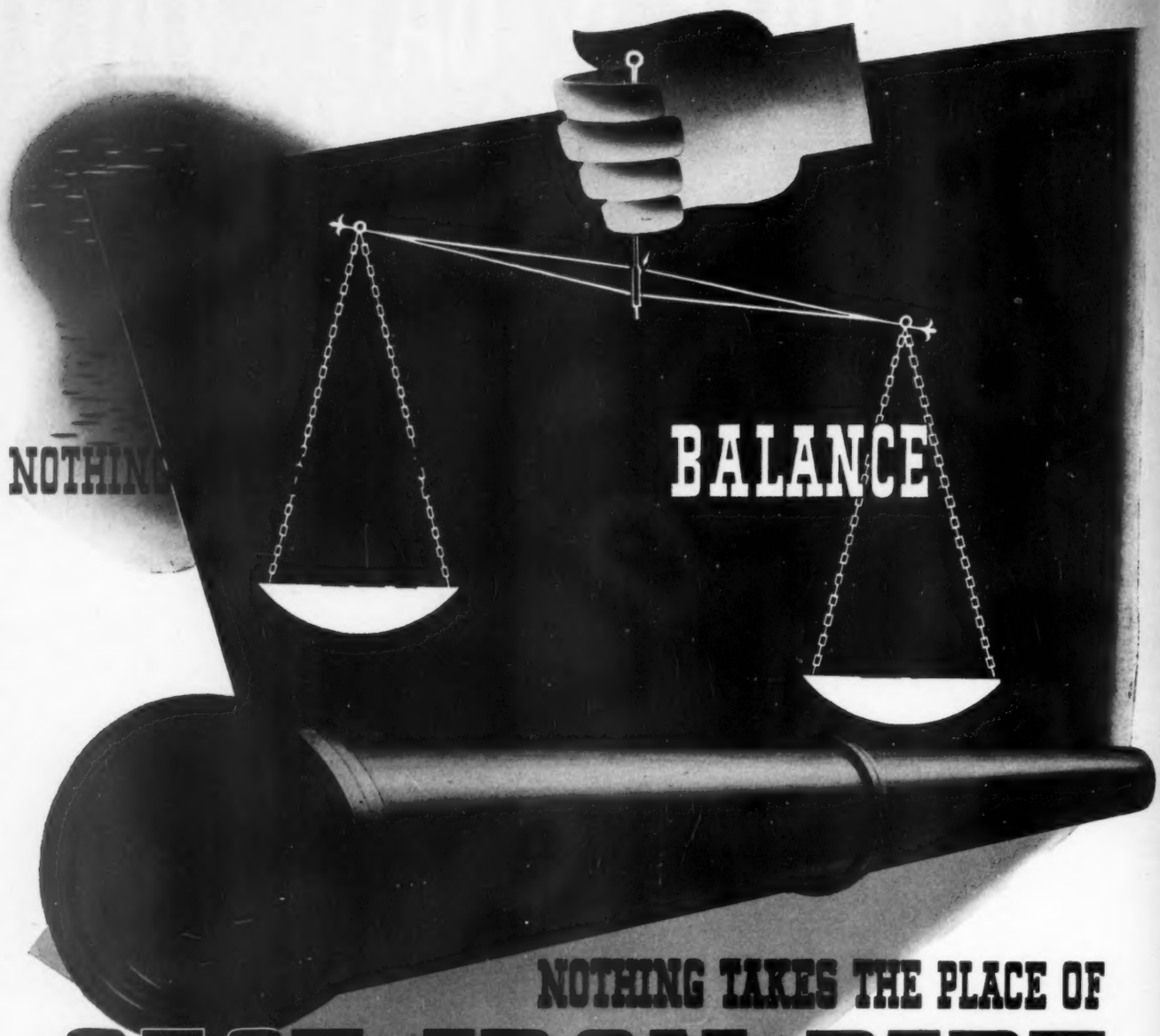
Please send me a copy of your A-300 Catalog at once.

Name_____

Position_____

Address_____

City_____



NOTHING TAKES THE PLACE OF

CAST IRON PIPE

THE STANDARD MATERIAL FOR UNDERGROUND MAINS

Recent installation of 30-inch cement-lined cast iron pipe at Washington, D. C. for District of Columbia Water Department.

FOR weighing, nothing since biblical days has supplanted the beam balance with two scale pans. For underground mains the standard material today, as for two centuries, is long-lived, economical cast iron pipe.

If you want long life and low maintenance cost that result from effective resistance to corrosion—assured safety margins for impact, beam load and crushing stresses—and permanently tight joints—then you will agree that nothing takes the place of cast iron pipe. Some materials meet some of these requirements but only cast iron pipe meets them all.

Look for the "Q-Check" registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.

THE CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER, 1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

DESIGN AND OPERATION OF THE TOPEKA ACTIVATED SLUDGE PLANT

Part 1. Design Features

By T. R. HASELTINE*

With the cooperation of W. E. Baldry, City Engineer, and P. E. Kaler, Plant Chemist, Topeka, Kanssas

The Author

A SANITARY survey of the Kansas River made in 1922 indicated an enormous increase in its pollution just below the city of Topeka, Kansas. Because of this fact and its possible danger to the water supply of Lawrence, a city about twenty miles below Topeka, the State Board of Health ordered Topeka to take suitable steps to reduce the contamination of the river. Mr. Charles A. Haskins, Consulting Engineer of Kansas City, Mo., was called in by the city.

Topeka is divided by the Kansas River and numerous smaller streams into four distinct drainage districts. Practically all the sewers that had been built up to that time carried the combined flow of sanitary sewage and storm water. The meat packing industry was well established in the city there being three separate plants. The wastes from that industry together with those from the Santa Fe Shops, a large creamery and many smaller industries produced a heavy pollutional burden on the river in addition to that from the domestic sewage.

After a thorough study of the entire problem Mr. Haskins recommended the immediate construction of two primary plants; one, to serve the north side district and the other to serve the east side, including the meat packing industry. The two plants together would serve approximately two-thirds of the residents and practically all of the waste producing industries. It was believed that such measures would sufficiently reduce the pollution of the river so that it would not be necessary to provide treatment from the western and southwestern districts at that time. Acting on those recommendations the city instructed Mr. W. E. Baldry, City Engineer, to prepare plans for the necessary interceptors and storm by-passes. Mr. Haskins was instructed to prepare plans for the two treatment plants and a pumping station and force main to the East Side plant.

The North Side plant affords primary treatment by means of Imhoff tanks. Provisions were made for the future addition of trickling filters, but, to date, it has not been necessary to construct them.

The East Side interceptor concentrates the sewage at the so-called Ash Street Pumping Station, from which it is pumped through 4,700 feet of 30 inch cast-iron force main to the East Side plant. The maximum economical capacity of this force main is about 8,000 to 9,000 g.p.m. for peak dry weather flows.

The sewage from the packing district is concentrated at another point and pumped once before it reaches the Ash Street station. The packing wastes receive no preliminary treatment and, during the summer at least, are quite septic when they reach the Ash Street station.

The East Side plant as originally built afforded primary treatment by means of a mechanically cleaned bar screen, detritor, two traction clarifiers, two heated sludge digestion tanks equipped for gas collection, sludge drying beds and miscellaneous appurtenances. This plant will be described in greater detail in conjunction with the discussion of the additions and alterations which have been made to it.

Soon after the plant was put in operation it developed that the large volume of septic packing wastes combined with the domestic sewage to produce many obnoxious odors about the plant. Even at the pumping station the sewage had an excessive chlorine demand, and pre-chlorination for odor control was discontinued because, at the time, the budget could not stand the added cost.

The primary treatment given the sewage at the North and East Side plants materially reduced the pollution of the river for a few years, but the growth in population and industry, coupled with low stream flows, soon outstripped primary sewage treatment. The pollution of the river increased until it was even greater than in 1922. Odor nuisances about the East Side plant were a source for potential damage suits. The city was desirous of correcting those conditions.

Mr. Haskins was called in again to advise the city and submitted a report that indicated that the construction of an activated sludge plant to treat the effluent of the East Side plant would prove the most practical measure. The city accepted his recommendations; plans were prepared and the work was let in two contracts: The first was concerned principally with the improvement of the primary treatment and included the housing of many of the primary units as an odor control measure; the second involved the construction of the activated sludge plant and additional sludge digestion units. The total cost of the work was approximately $315,000 of which about $90,000 was a grant from the Public Works Administration. The first contract was let in February, 1935, and completed in September of that year. The second contract was let in January, 1936, and completed in March of the following year. The George Senne Construction Company of Topeka had both contracts. The author was in the employ of Mr. Haskins from May, 1935, to April, 1937, during which time he had full charge of the design, construction and initial operation of the units included in the second contract. Since leaving Topeka he has been in close contact with Mr. P. E. Kaler, plant chemist, and Mr. W. E. Baldry, city engineer, to whom he is indebted for assistance in preparing this article.

*Supt. of Sewage Treatment, Butler and Grove City, Pa.; formerly with Charles A. Haskins, Consulting Engineer, Kansas City, Mo.

Design Basis

The absence of any analytical data or even actual flow measurements over long periods of time was a handicap to logical design. No chemist was employed prior to 1937, and officials of the various meat packing concerns would venture no forcasts as to the future of that industry in Topeka. The future pumping of the domestic sewage from either the west or southwest districts to the east side plant was a possibility requiring consideration. The 1933 sewage flow at the plant as estimated from pump efficiencies, running times, and power consumption was as follows, about 1 m.g.d. of which was believed to be packing plant wastes.

	M. G. D.
Dry weather average	4.5
Dry weather maximum hourly	6.2
Dry weather minimum hourly	2.7
Wet weather maximum hourly	13.0

Sewage analyses made during July 1933 gave the following average results in parts per million.

	Domestic Sewage	Packing Wastes	Combined Sewage
Total solids	1,005	2,693	1,372
Total volatile solids	265	1,013	429
Suspended solids	194	548	264
Volatile suspended solids	118	423	211
5 day B. O. D.	220	592	343
Organic nitrogen	12.3	81	21.4
Grease	60	1,481	116

The foregoing data indicated a population equivalent of 66,000 to 75,000. The actual population of the area tributary to the plant was estimated at 40,000; the balance was due primarily to the packing plant wastes.

The plant as originally constructed and revamped under the 1935 contract consisted of the following principal units. The units and appurtenances added under the second contract (1936) are described later on.

*1. *Bar Screen:* Jeffrey, mechanically cleared, 5 ft. wide by 5 ft. deep, ⅜-in. by 2-in. bars with 1-in. clear openings inclined 30 deg. from vertical. Float control of mechanism.

2. *Dorr Detritor:* 26 ft. diameter, 647 sq. ft. area, liquor depth 2.0 to 2.67 ft., 13,000 gals. maximum volume.

*3. *Pre-aeration and Grease Removal Tank:* 1,200 sq. ft. area, 81,000 gal. capacity; two channels 15 ft. wide by 10 ft. deep with intervening around-the-end baffle; ridge and valley bottom with 160 sq. ft. of porous diffusor tubes suspended in the valleys. No aeration at outlet end which is designed for scum collection and to prevent sludge deposits.

4. *Primary Clarifiers:* Two Door traction type, total area 9,612 sq. ft., total capacity 686,000 gallons.

*5. *Brick building* housing the above units approximately 90x210 ft. in plan, 11 ft. side height and 23 ft. center height—unheated.

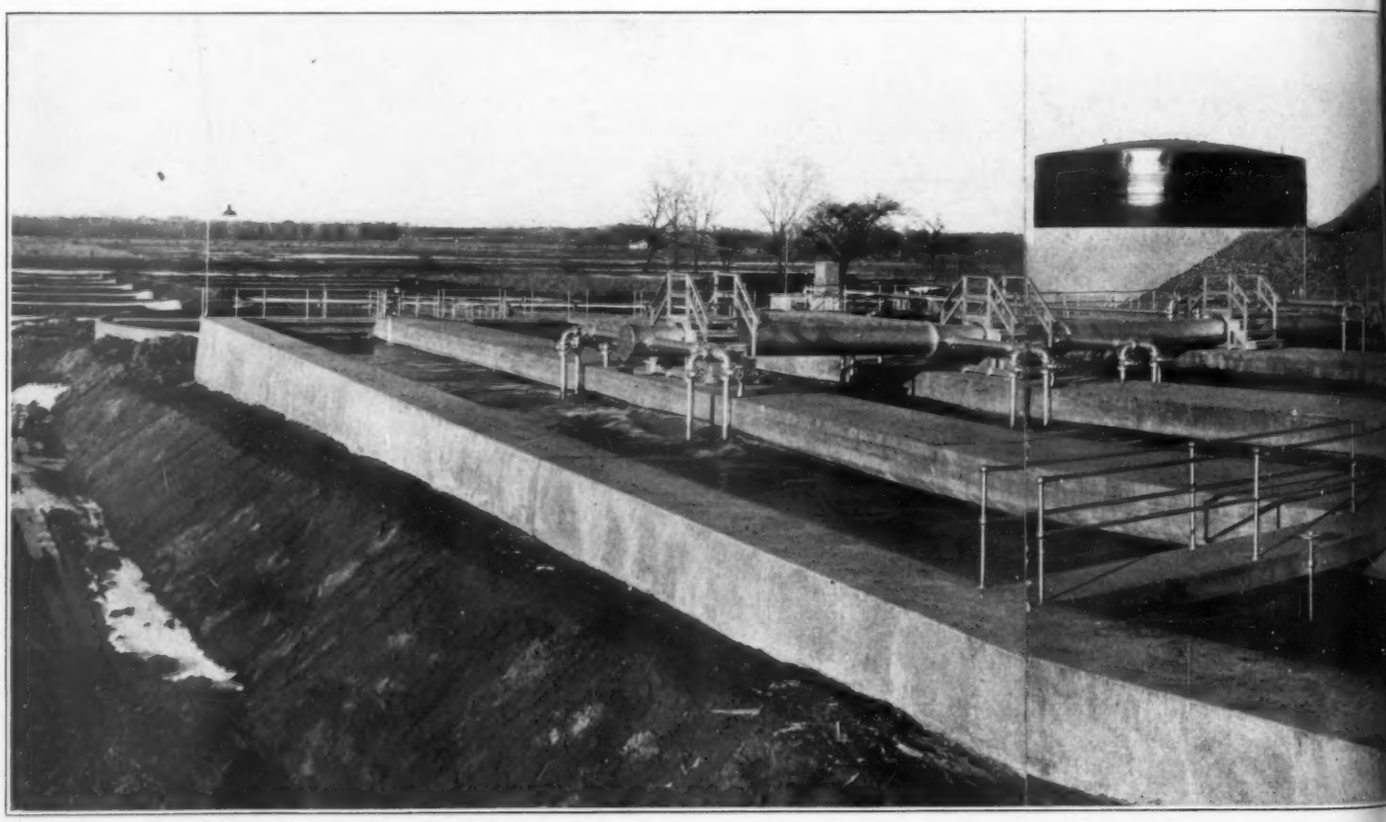
6. *Sludge Pump House* housing two "old type" Dorrco diaphragm sludge pumps, two Bryant boilers, circulating pumps, etc.

7. *Digesters:* two tanks 65 ft. diameter, 23 ft. deep, combined capacity 152,000 cu. ft., equipped with Dorr center drive stirring mechanisms.

8. *Sludge Drying Beds:* Eight underdrained sand beds 30 ft. by 120 ft., giving an area of 28,800 sq. ft. Industrial track and push cars to facilitate their cleaning.

As previously stated, the force main from the Ash Street pump station to the plant was adequate for an average dry weather flow of 9 m.g.d. At such a flow the theoretical displacement period would be 13 minutes in the preaeration tank and 1.8 hours in the primary clarifiers. The overflow rate in the clarifiers would be 935

*Indicates units added in 1935.



General View of the

(Left to Right) Sludge Beds; Final Clarifiers; Aeration Battery; Combination Gas Holder and 3rd Stage Digester; Pump, Engine and

gallons per sq. ft. per day. It was believed that these units and the bar screen were adequate for handling such flows and that, therefore, 9 m.g.d. was about the maximum average dry weather flow for which extensions should be designed.

However, funds were not available for constructing all units of the extended plant for average flow of 9 m.g.d. Therefore the aeration tanks and final clarifiers were designed for an average dry weather flow of but 6 m.g.d., with provisions made for their future extension. It is hydraulically possible to put peak wet weather flows of 13 m.g.d. through the entire plant. The sludge digestion facilities were enlarged in anticipation of handling the primary and secondary sludges from an average flow of 9 m.g.d.

Since it was necessary to limit the capacity of either the aeration or digestion facilities it appeared logical to reduce that of the former, in view of the rapid strides being made in the science of sewage treatment at the present time. One of the outstanding features of that growth is the development of several processes of chemical treatment. It is quite possible that the next few years will see the perfection of some chemical process whereby the strength of the Topeka sewage might be so reduced that a considerably shorter aeration period would suffice than is now required and consequently less of the bulky activated sludge to handle.

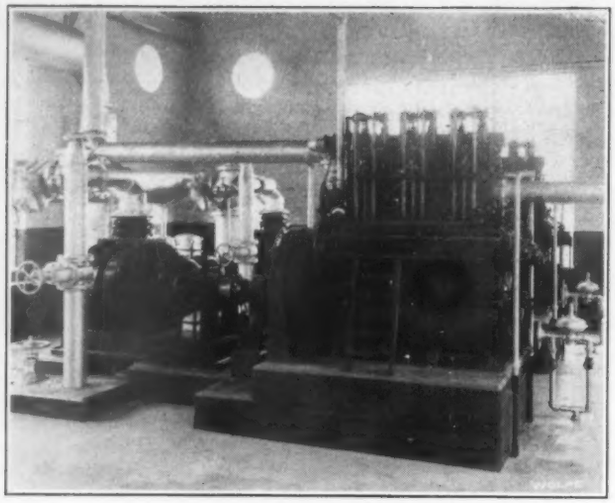
New Units and Appurtenances

Vertical Flow Grit Chamber

The Dorr detritor already installed proved satisfactory for removing the grit from flows up to 10 m.g.d., but was entirely inadequate for handling the large volumes of grit which came down during peak storm flows. Since the detritor had a theoretical displacement period of 1.45 minutes at a 13 m.g.d. rate of flow, it appeared that the unsatisfactory results obtained were due, not so much to excessive flows, as to excessive amounts of grit in the sewage. On several occasions attempts to put heavy storm flows through the detritor resulted in such heavy deposition of grit that the detritor mechanism rode over the heavy storm flow grit and left the peripheral rail. This substantiated the belief that the trouble was due to unusually large amounts of grit per unit volume of sewage, rather than to poor deposition in the detritor. Therefore, a vertical flow grit chamber was constructed ahead of the detritor as part of the 1936 contract. The design of this unit was based upon the work of H. Blunk in Germany (Sew. Wks. Jour., vol. 9, p 509). It is designed for flows of from 10 to 13 m.g.d. At such flows the sewage will have an upward velocity of from 0.15 to 0.195 feet per second throughout a vertical distance of 10 ft. Blunk showed that the maximum settling velocity of organic matter was 0.10 to 0.13 ft. per sec., so very little organic matter should settle in this chamber. He also showed that the minimum settling velocity of sand 0.5 to 1.0 mm. in size was 0.22 ft. per sec., so practically all such material should be removed. The inlet of this grit chamber is set just slightly above the hydraulic gradient so that normally no sewage will pass through the chamber. At times of storm the operator closes an electrically operated gate valve which throws the chamber into service. While in operation grit is discharged continuously to a plant bypass through a 6-inch riser. After the storm the chamber may be drained. This unit proved very efficient in handling the run-off from the February, 1937, thaws at rates of 11 to 12 m.g.d. Attempts to use it on flow rates less than 10 m.g.d. (for which it was not intended) showed a tendency for the grit drawoff line to clog, thus necessitating hand cleaning of the structure. After this unit had been avail-

Revamped Topeka Plant

Blower House; House (with vent stacks) over Screens, Grit Chamber and Primary Tanks—some call it a "sweat-shop."



Twin Engine—Blower Units at Topeka
(Worthington engines are direct-connected to Roots-Connersville blowers with capacities of 4,000 cu. ft. of air per minute against 8½ lbs. pressure.)

able for one year Mr. Baldry stated that by its use it had been possible to handle all storm flows received, but that there had been so few heavy rainfalls (total absence of continuous periods of storm flows) that there has been little opportunity to demonstrate the value of the unit.

Ventilation of Primary Plant

There are numerous dwellings in close proximity to the plant. Many of the residents had threatened suit against the city unless the odor nuisance arising from the plant was abated. Therefore the 1935 contract included the construction of a brick building to house the bar screen, detritor, preaeration unit and primary clarifiers in an attempt to confine odors arising from them.

Although sewage plants have been successfully housed elsewhere, trouble soon developed at Topeka. During the winter of 1935-36 wall and roof condensation was so pronounced that one almost needed a raincoat to enter the building. As a part of the 1936 work four ventilating fans, each of 8,000 cu. ft. per min. capacity, were installed to correct that condition. Those fans discharge through 12 ft. stacks located on top of the building; their combined capacity is, theoretically, sufficient to cause one complete air change in the building every 10 minutes. Each fan is individually controlled and each stack has a damper that may be closed when the fans are not in service. The fans were furnished by the American Blower Co. and consists of aluminum fans driven by totally enclosed moisture proof General Electric motors.

At first thought it seems absurd to construct a building to retain odors and then install fans to blow them out. However, the fans can be shut down when weather conditions demand, and, when they are in use, they discharge those odors at high velocity some 35 ft. above the ground instead of permitting them to be wafted gently along the earth's surface as they were in the past. During the past summer the sewage has not been chlorinated at all and although a few odor complaints have been received the building and ventilation system has been truly effective in reducing the number and seriousness of such complaints.

During the coldest winter days the fans are not able to keep down condensation sufficiently to entirely eliminate drip; the building is still filled with a dense fog. Large amounts of water collect in the stacks. The fans stood up quite well during the first winter, but Mr. Baldry reports that during the second winter considerable trouble was encountered with motor short circuits and that even the aluminum blades showed signs of corrosion. Rusting of all metal work within the building is a serious problem and the maintenance of electrical equipment is a never ending task. While conditions outside the building have been greatly improved the working conditions for the operators inside the building are far from satisfactory—both summer and winter. Just why the housing of plants should prove satisfactory at some places, even without special ventilation features, and still be so unsatisfactory at Topeka where such features are provided is difficult to understand. Perhaps the explanation lies in the relationship between sewage and air temperatures. In that connection Table I may be of interest. Topeka sewage temperatures appear to be unusually high, probably reflecting the effect of packing plant and other wastes. The public water supply is a surface supply.

Table I

Month	Raw Sewage Temperature	Air Temperatures Mean	Air Temperatures Avg. Daily Max.
February, 1937	66	30	39
March	61	39	49
April	71	54	65
May	76	68	79
June	81	76	87
July	84	83	96
August	87	84	96
September	85	72	84
October	81	57	69
November	76	40	50
December	71	31	38
January, 1938	72	32	..
February	70	37	..

Aeration Tanks

The piping and channels around the primary plant have been so altered that the effluent from the detritor may be taken direct to the aeration tanks. Or, any part of the effluent from both clarifiers may be bypassed around the aerators. All sewage flowing to the aeration tanks from the primary clarifiers passes through a venturi meter equipped with a flow recording device. The recorder has given considerable trouble (perhaps because it is located in the humid and corrosive atmosphere of the primary tank buildings) and hence the flow records obtained are, at best, spotty and approximate.

Sewage enters the aerators through a distributing weir box at one end of the tanks. There are two aeration tanks, each of which consists of three passes 15 ft. deep, 20 ft. wide and 139 ft. 6 in. long. These afford 6 hours aeration for a flow of 6 m.g.d. plus 20% return sludge. There is, also, one re-aeration tank, similar to one pass of the aeration tanks but at a slightly higher level so as to permit the re-aerated sludge to flow into the distributing weir box and thence back to the aeration tanks. This tank affords 6 hours re-aeration for 1.2 m.g.d. return sludge (20% of 6 m.g.d.). Piping is arranged so that either of the aeration tanks or the re-aeration tank may be taken out of service without affecting the operation of the other units. The division of sewage, sludge, or both, between the two aeration tanks may be varied by means of adjustable weirs in the distributing weir box.

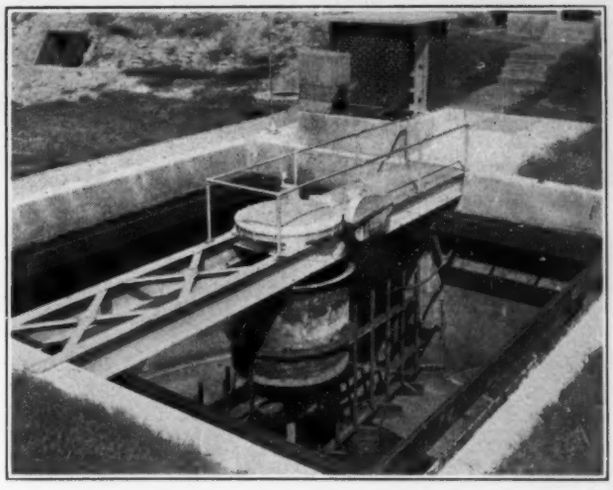
Aeration is accomplished by blowing air through diffuser plates which form the "roof" of air ducts cast in the tank floor. There are three ducts, 11x11 inches in cross section, running longitudinally along one side of each pass. The diffuser plates are supported across these ducts by means of aluminum tees cast in the floor. The diffuser plate area is about 9.2% of the tank area. Air is distributed through a 24-inch header across the top of the

tanks at their center. Branches off this header (4 inch) feed each duct so that 43 diffuser plates are controlled by a single valve. Although a range in permeability of 36 to 44 was permitted on the job, it was required that all plates controlled by a single valve should have the same permeability rating within 0.5 cu. ft. The plates of highest permeability were placed in the re-aeration tank, those of next highest permeability in the inlet bays of the two aeration tanks, and those of least permeability in the outlet bays of the aeration tanks. This method of aeration does not give perfectly uniform air distribution along the full length of the ducts. Aeration is frequently more violent near the supply pipes, and again at the ends of the tanks, with less turbulence in between those points. However distribution is quite satisfactory so long as the air supply is not reduced below 1.9 cu. ft. per min. per sq. ft. of diffuser area, i.e., a total of 3,500 cu. ft. per minute. Very poor distribution is obtained at rates of 1.35 cu. ft. per minute per sq. ft. of diffuser area.

Final Clarifiers

Two final clarifiers 75 ft. in diameter and 11 ft. deep have been provided. Mixed liquor enters at the center and overflows circumferential weirs; total overflow weir length 470 ft. A detention period of 2.4 hours and an overflow rate of 815 gallons per sq. ft. per day results when treating a flow of 6 m.g.d. plus 20% return sludge. They are equipped with Chain-Belt Company's "Tow-Bro" sludge removal mechanisms, i.e., nozzle sludge take-offs on hollow revolving arms, so designed as to pick up sludge from the entire bottom area without first plowing or scraping it to a sump or hopper.

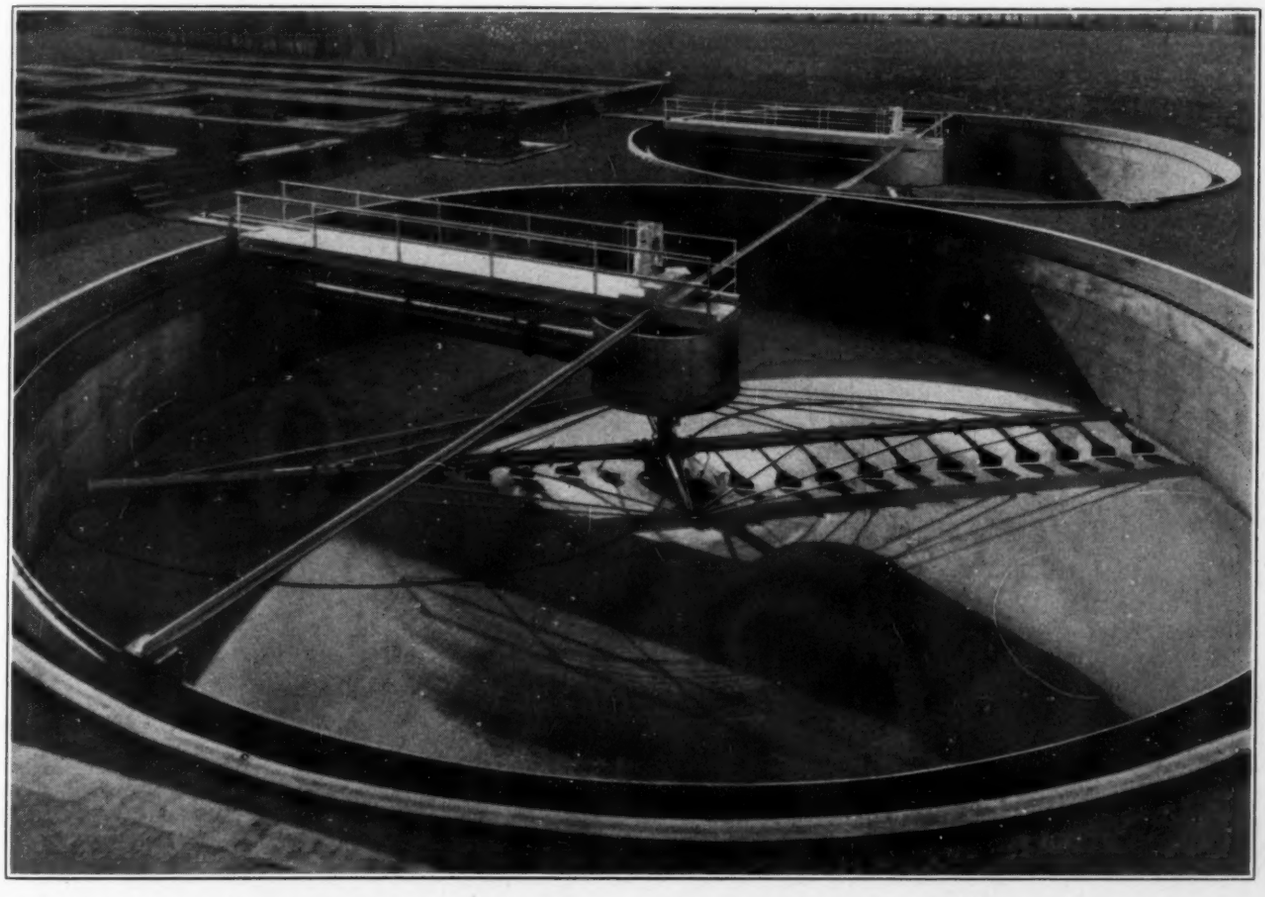
Sludge from the final clarifiers is lifted by air lifts to a diversion box from which it may flow to (a) the re-aeration tank, (b) the inlets of the aeration tanks, (c) a sludge thickener, or (d) a variable speed sludge pump of 75 g.p.m. maximum capacity. This pump can discharge to the digesters or to the pre-aeration and grease removal tank. Weirs and indicating, integrating and recording devices have been provided to measure the amounts of sludge returned and wasted.



Dorrco Sludge Thickener
(Note the small size of this unit for a 6 M.D.G. plant. Also note the chlorine hose line suspended for topwater chlorination to check fermentation and bulking of activated sludge.)

Sludge Thickener

Handling of the large volume of excess activated sludge constitutes one of the serious drawbacks to the activated sludge process. In some of the earlier plants an attempt was made to dispose of excess sludge from final



The New Secondary Clarifiers—Center Feed with Chain-Belt "Tow-Bro" Sludge Removal Mechanism.

clarifiers by pumping it directly into the digesters. It was found that this practice was generally unsatisfactory because of the large liquid volume and low solid content of the sludge. To avoid that difficulty most plants now return the waste activated sludge to the raw sewage and permit the sludge floc to settle out with the raw sewage solids in the primary clarifiers. This practice is fairly satisfactory in so far as avoiding digestion troubles is concerned, but usually it increases the B.O.D. and solid content of the settled sewage, thereby increasing the load on the activated sludge process proper and gradually drags down its efficiency. Such practice not only materially increases operating costs, but reduces the degree of treatment obtainable, and may cause sludge bulking or allied difficulties in the process.

At the Topeka plant provision is made for either of the two methods of disposing of the waste sludge. But, in addition, a sludge thickener has been provided. It consists of a round-bottomed square tank having a surface area of 544 sq. ft., a volume of 41,800 gallons and a side water depth of 10 ft. The influent enters at the center of the tank and passes out over 92 ft. of peripheral overflow weirs. Mixed liquor from the aeration tanks, waste activated sludge from the final clarifiers, overflow liquor (supernatant) from the digesters, or any combination of these, may be concentrated in this tank. Sludge is drawn to a central cone by a center-drive clarifier mechanism manufactured by the Dorr Company. The clarifier arms have, in addition to the usual brass squeeges, vertical pickets that extend 5 ft. above the tank floor. This mechanism is designed to facilitate the escape of entrained gases, thus assisting sludge compacting and reducing the tendency for gas buoyed sludge to rise to the surface. A chlorinator is so installed that the contents or the surface water in the thickener may be chlorinated to retard bacterial activity and thus assist sludge thickening. The thickened sludge is pumped to the digesters by means of a 75 gpm. maximum capacity variable speed sludge pump. The effluent (supernatant) from the thickener may flow by gravity to the river or be pumped, by means of another variable speed pump, back to the preaeration and grease removal tank. This second pump has a capacity of from 50 to 700 gallons per minute.

Sludge Digestion

The old digesters had always given a great deal of trouble due to scum formation. In the past it had been necessary to discharge large amounts of semi-digested scum onto low land adjacent to the plant. The gentle stirring produced by the old Dorr equipment was of little or no avail in combating scum; in fact, the scum (aggravated by packing house wastes) built up so rapidly that it simply overloaded the mechanisms. The operators found that, by introducing the fresh sludge at the bottom of the old digesters (which were operated in parallel), instead of at their tops as originally intended, they obtained a more intimate mixture between fresh and digesting sludges which reduced scum troubles but did not eliminate them. The chief disadvantage to this practice was that considerable poorly digested material was drawn out with the digested sludge onto the drying beds.

The primary cause of scum formation was undoubtedly the large amount of packing house wastes (grease and paunch manure) in the Topeka sewage. However, at nearly all plants where comparisons have been made between the digestion of primary sludge alone, and of a mixture of primary and activated sludge together, it has been found that the mixed sludge produced the most scum. It was evident, therefore, that any new sludge digestion facilities at Topeka should be particularly designed to combat scum formation. It has been repeatedly demonstrated that seeding of fresh solids with digesting sludge hastens its digestion. Without adequate mixing the heavy scum at the top of a digestion tank may not receive sufficient seeding, even though there is considerable good seeding material in the bottom of the digesters. Scum will digest eventually if it is submerged, but, unless its rate of digestion is equal to or greater than the rate of introduction of scum forming material, scum troubles are bound to occur.

Since scum submergence and heating had both been practiced at Topeka without preventing scum accumulation, it appeared logical to resort to more efficient seeding to hasten sludge digestion. Therefore, it was decided to construct a new digester 65 ft. in diameter, 30 ft. deep, capacity 99,500 cu. ft., to provide stage digestion. This tank is termed the primary digester. Under normal operation all sludge from the primary clarifiers and sludge thickener are pumped to this tank first. It was estimated that the average retention period in this tank would be about 20 days. Bids were received on two alternate methods of scum seeding:

1. Dorr turbo-mixers suspended in the sludge, which it was claimed were capable of maintaining a homogeneous mixture throughout the tank, thus preventing scum separation and hastening the digestion of scum forming material.

2. Centrifugal pumps suspended in the tank and so arranged that supernatant liquor could be pumped onto the scum, thus forcing it down, seeding it, and so hastening its digestion. Patents on this process are held by the Pacific Flush Tank Company.

The lowest bids were received on the Dorr Turbo-Mixers, so that equipment was used. Three turbos were installed, each of which has three impellers located, respectively, near the bottom, middle and top of the tank. There are two tank outlets, one from the bottom and one from 10 ft. below the roof. Both of these lines are carried up to a box into which they overflow and from which sludge or liquid may flow to either one or both of the old digesters or to a new gas holder to be described later. Piping is so arranged that any one of the three digesters or the gas holder can be taken out of service. A tipping-bucket meter and automatic sampler is provided for measuring and sampling all sludge pumped to the primary digester.

Gas Holder-Digester

The gas holder is a concrete tank 56 ft. in diameter with a side-water depth of 21 ft. and a conical bottom. Its capacity is 56,000 cu. ft. This tank is really another digester. Thus sludge digestion at Topeka is now a three stage process. The first stage, of approximately 20 days, occurs in the large new primary digester; it is accompanied with more or less violent agitation. The second stage occurs in the old digesters, assisted by very gentle stirring. The third stage, which occurs in the gas holder, receives no mechanical mixing. Since gas production, and therefore activity, is at a minimum by this time, this stage should produce a denser sludge and clearer overflow than might be expected from the preceding stages. The combined digestion capacity of the three stages is 307,500 cu. ft. The gas holder overflow (supernatant) normally goes back to the preaeration and grease removal tank, but, in event it is high in suspended matter, it may be discharged to the sludge thickener. All sludge that is drawn onto the drying beds normally comes from the gas holder, although it is still possible to draw sludge from the old digesters if so desired. While the other three digesters are covered with fixed

concrete roofs, the gas holder is covered with a steel gas bell which is lifted by gas pressure. Gas generated in the other three digesters is piped to this holder. When fully inflated, the floating gas bell holds 40,000 cu. ft. of gas under a 4-ounce pressure.

Gas Utilization

One gas line leads from the holder to the old heating boilers, another to two new gas engines. It was believed that ordinarily the engine cooling water would provide sufficient heat for the digesters and buildings; however, the old boilers were retained for emergency service. By supplying them through a different line than that which supplies the engines, the possibility of the engines "sucking out" the boiler flames was avoided.

The two new gas engines are 3-cylinder 12¼x14½-inch, twin ignition, Worthington engines. They are each direct connected to Roots Connersville blowers, rated at 4,050 cu. ft. per minute against 8.5 pounds pressure when operating at 400 RPM. These units can supply air for the preaeration unit as well as for the activated sludge process. Space has been provided in the building for an additional engine of about 330 H.P. direct connected to an additional blower of 7,200 cu. ft. per minute capacity. The blowers, as well as the engines, have force feed lubrication and both are equipped with oil coolers. An electric pyrometer is provided for determining the exhaust temperatures of each individual engine cylinder. Safety devices are provided that will shut either unit down automatically in event any of the following conditions exist:

Oil temperature excessive; oil pressure inadequate; cooling water temperature excessive; excessive rotative speed; blower oil pressure inadequate; electric power failure.

Table II indicates the overall efficiencies of these units as (a) specified by the engineers, (b) guaranteed by the manufacturer, and (c) as determined by actual test. All tests were made when using sludge gas having a net heating value of 647 btu. per cu. ft. when measured at an absolute pressure of 30 inches of mercury, and the pipe line temperatures then prevailing. Air measurements were made under temperatures and pressures existing at the blower intakes.

TABLE II

	Approximate Speed R.P.M.	Blower Discharge Pressure lb./Sq. In	Cu. Ft. of Air Per Min. Per 1,000 B.t.u. Per Hour
Engineers' specifications	400	8.5	2.00
	300	8.5	1.87
Manufacturers' guarantee ..	400	8.5	2.31
	300	8.5	2.14
	400	8.4	2.36
	350	8.3	2.36
Actual Test of No. 1 unit...	300	8.5	2.24
	300	7.0	2.63
	300	6.15	2.99
	350	6.2	2.95
	400	8.8	2.27
	350	8.8	2.25
Actual test of No. 2 unit....	300	8.7	2.18
	300	7.15	2.55
	300	6.2	2.96

An economic study of purchased gas and electric power costs at Topeka indicated that it would be cheaper to operate these engines entirely on purchased gas, if necessary, than it would be to provide only one gas engine and to drive the other blower with an electric motor. However, since conservative estimates of sludge gas production indicated daily yields of 60,000 to 70,000 cu. ft., there appeared little possibility of ever operating on purchased gas other than to a minor extent. Nevertheless, the possibility of using some purchased natural gas had to be provided for. Therefore, the engine mixing valves were designed for all sludge gas, all natural gas, or any combination of the two. But, because of the difference in heating value of the two gases, it was believed that more efficient and convenient operation would result from a mixture of the two than from switching from one to the other and back again. Therefore, purchased natural gas, when used, will normally be introduced into the gas holder where it will diffuse into the sludge gas, and the resulting mixture will be drawn out to the engines. Either gas alone may be fed direct to the engines if the gas holder is out of service. Since the local gas utility could not guarantee sufficient pressure to force their gas into the holder, a booster pump having a maximum capacity of 10 cu. ft. per minute was installed for that purpose.

It was previously stated that normally the engine cooling water would suffice to heat the four digesters and the various buildings. If that is the case, it is evident that during the summer difficulty might be encountered in cooling the engine water sufficiently. To provide for that condition approximately 950 linear feet of 3-inch pipe coils were installed in the aeration tanks, through which a portion, or all, of the cooling water could be circulated.

Air Filters

Since Topeka is subject to occasional dust storms the question of adequate air filters was given particular attention. The specifications adopted required that the filters should have a cleaning efficiency of not less than 80% in removing cottrell precipitate from the air, as measured by test methods established by the National Bureau of Standards (a dust *count* method rather than a *gravimetric* method). A certificate of test made by an independent laboratory was required. The filters selected were Coppus Air Filters. The writer believes that those filters had never been used in a sewage treatment plant before. The filter medium is a 14-ounce all-wool felt. It is cleaned by an especially designed vacuum cleaner. A filter bank having a capacity of 19,200 cu. ft. of air per minute, with an initial (clean) pressure drop of 0.2 inches of water gauge, was installed. A manometer type gauge was provided to indicate the pressure drop through the filters at all times. These filters have never been required to operate at more than about half of their rated capacity. The maximum pressure drop ever observed through them was 0.5 inches. They are cleaned every two weeks as a matter of regular routine. Cleaning has always reduced the pressure drop to about 0.1 inches. The blower discharge pressure is the same now as it was a year ago, thus proving the filters to be entirely satisfactory.

Sludge Drying Beds

The original plant had eight drying beds 30 ft. by 120 ft., in plan, and of the conventional underdrained sand type. At times they had not proved quite adequate. In view of this, and the probable increase in amount of sludge to be dried, eight new beds 60 ft. by 120 ft., in plan, were constructed. These new beds are simply leveled areas of the naturally sandy soil, with earth embankments between them. It was not believed judicious to provide more elaborate sludge drying facilities at that time in view of the rapid developments in vacuum filtration, spray drying, centrifuging and similar new methods.

(*To be continued*)

[Part II of Mr. Haseltine's article will be devoted to "Operating Experiences" at the revamped Topeka plant.]

A WATER TOWER A-FIRE
(Believe It or Not!)

By F. J. RENY
Genl. Mgr., Portland Water District, Portland, Me.

Portland's Standpipe Aflame; Four Painters Barely Escape

IT WAS Thursday morning, Sept. 8, 1938. An alarm of fire was received on the South Portland system. And (Believe It or Not!) it proved to be the standpipe of the Portland Water District.

This standpipe had been emptied and was being refinished outside and inside according to approved painting specifications. After having red-leaded the places on the standpipe, where the paint had worn off, it had been covered with two coats of aluminum. So the outside of the standpipe was completely finished, even including the lettering.

On the inside of the standpipe specifications called for a complete scraping and cleaning job, and then the entire inside to be covered with a priming coat, after which a hot coat of Bitumastic Enamel was to be applied. The contractor had applied the priming coat and had nearly finished the coat of hot coal-tar enamel, in fact was down to the last two plates on the standpipe. One of his workmen had a small quantity of gasoline, less than a gallon they say, which he was using to wash his hands. It is not known just exactly whether somebody was smoking a cigarette or whether somebody lit a match, but the contractor claims that all of a sudden there was a fire which started under the boatswain chair where one man was working, about 30 feet up on the plates.

The four men on the inside of the standpipe all proceeded to try to beat out the fire with whatever was handy, but they were unable to do so, and inside of a very few seconds the whole inside of the standpipe was a roaring furnace. The four men escaped through the manhole very quickly and fortunately were all able to get out without serious burns.

Although the standpipe looked to be very hot, the smoke rolling out of the top made it look more terrifying than it really was. As it was, it simply burned off all of the coating on the inside and blistered all of the outside so that all of the inside was as good as a sand-blasting job and the outside was left with just the red lead showing in some places, which was the original coating. The only places that showed rust were on the two upper plates of the 77-foot structure.

Firemen played hose streams on the lower part of the standpipe, and braced a wheelbarrow against the manhole to stop the draft up through. After the smoke had stopped coming out of the top and the fire was out and the tank had cooled, an inspection was made by an engineer from the Portland Company of Portland, together with the Superintendent of the Water District.

It was decided to thoroughly scrape the inside of the standpipe again, wash it out, and apply a coat of primer; and, then to fill the standpipe with water to see if any leakages had occurred. This was accordingly done and two days later the standpipe was inspected, after having been filled to within a foot and a half of the top. There being no discernible leakage anywhere in the structure, that our inspectors could find, the water was drawn off again and the standpipe was repainted on the outside with aluminum, after having been thoroughly wire brushed. The inside was again treated with a hot coating of Bitumastic Enamel, this time there being somebody on the job to see that there were no matches, gasoline, or smoking in the immediate vicinity.

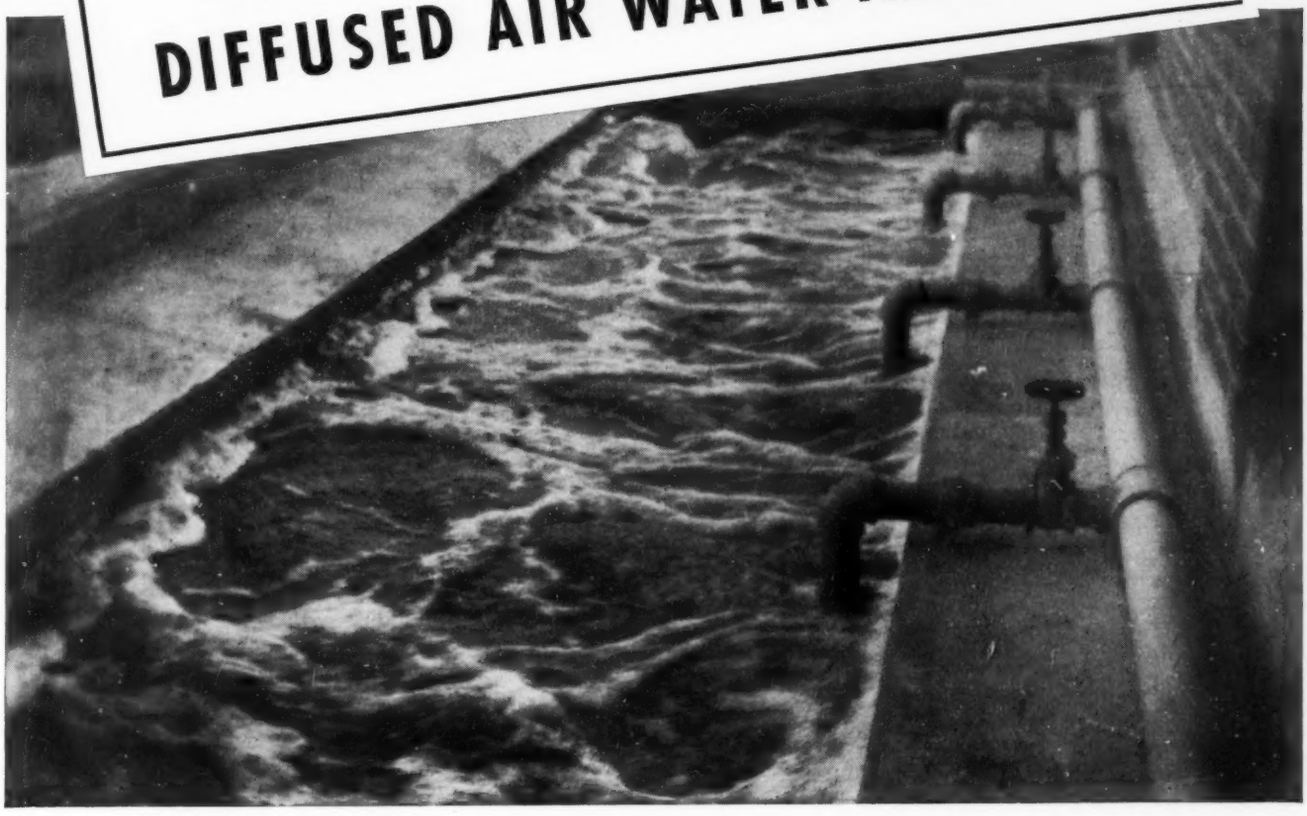
This standpipe, of wrought-iron plates, was the first one built by the Portland Water Company in 1892. It is 77 feet high by 36 feet in diameter and has a capacity of 602,000 gallons.

[The above story is based on a letter from Mr. Reny, reciting the incident, in explanation of the rather unusual picture.—Ed.]

Snapped at the Meeting of the Rocky Mt'n Section of A.W.W.A.—in Casper, Wyoming

(1) Ben V. Howe, Chief Engr., Colo. Dept. Health, Denver, Colo. (Section Secretary); Harry E. Jordan, Exec. Secretary, A.W.W.A., New York, N. Y.; L. O. Williams, State Sanitary Engr., Cheyenne, Wyo.; (2) Denver Water Department represented in full force; O. J. Ripple, Supt. Filtration; Geo. Hughes, Mgr.; D. D. Gross, Chief Engr.; Geo. Turre, San. Engr. and Chief Chemist. (3) H. G. Watson, Supt. Water, Cheyenne, Wyo. (4) Eugene Howell, Asst. Engr., Colo. Dept. Health, Denver; Chester A. Truman, Supt. Water, Colorado Springs (A.W.W.A. Director).—(Photos by Jack Harris, Ind. Chem. Sales Co.)

Reduce operating costs and improve treatment results by DIFFUSED AIR WATER AERATION



● The objective of your water aeration problem may be one or more of the following:

1. *"Sweeping out" of entrained CO_2 and other gases*
2. *Removal or reduction of taste and odor*
3. *Flocculation of iron*
4. *Efficient mixing of chemicals*

The operation economy and efficacy of air diffusion through porous diffusers for these applications is unsurpassed. Construction and installation costs are low as compared with other methods.

These benefits are realized because air diffusion is provided by simple, easy to operate equipment. The power requirement is low and the job is thoroughly done without auxiliary equipment.

There are now 27 cities making use of Aloxite Brand Diffusers to provide this effective aeration and mixing at an appreciable saving to their citizens. Write to our Sanitary Engineers for further details and for assistance on your aeration problem.

• • •

● *Use porous diffusers—the most efficient equipment for any aeration operation.*

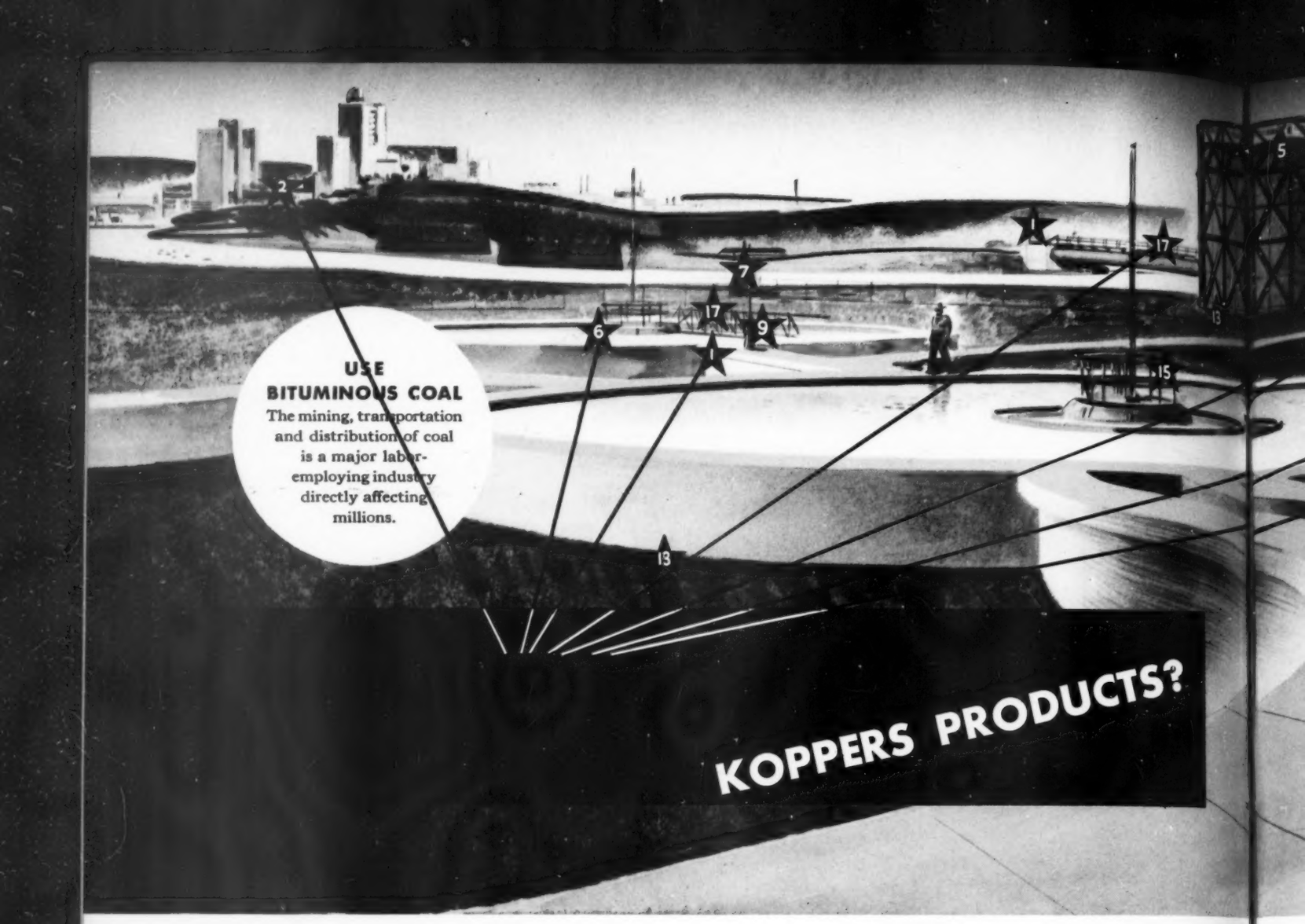
POROUS CARBORUNDUM BRAND PRODUCTS

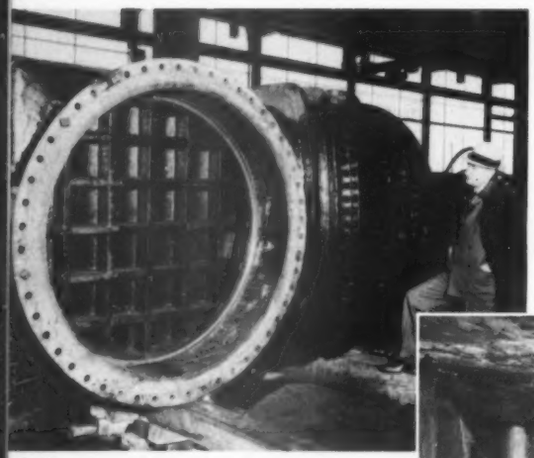
REG. U. S. PAT. OFF.

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

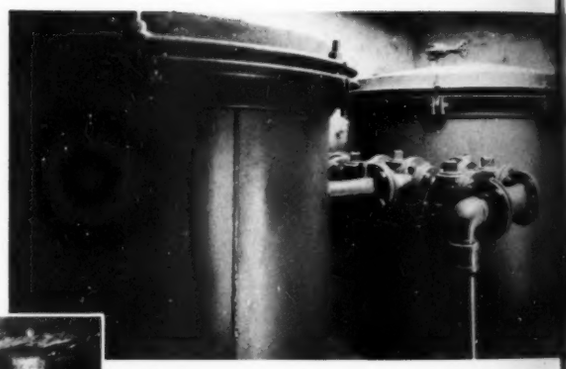
Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of The Carborundum Company)


USE
BITUMINOUS COAL
The mining, transportation and distribution of coal is a major labor-employing industry directly affecting millions.
KOPPERS PRODUCTS?

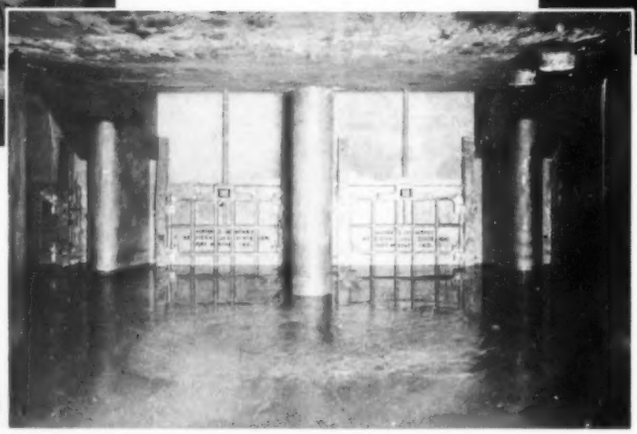


WESTERN GAS Division of Koppers produces both the Western and Michigan line of Gate Valves for sewage plants and waterworks. This photograph shows a 66" single-disc parallel seat hydraulic operated Western Gate Valve for the sewage disposal plant at Detroit.

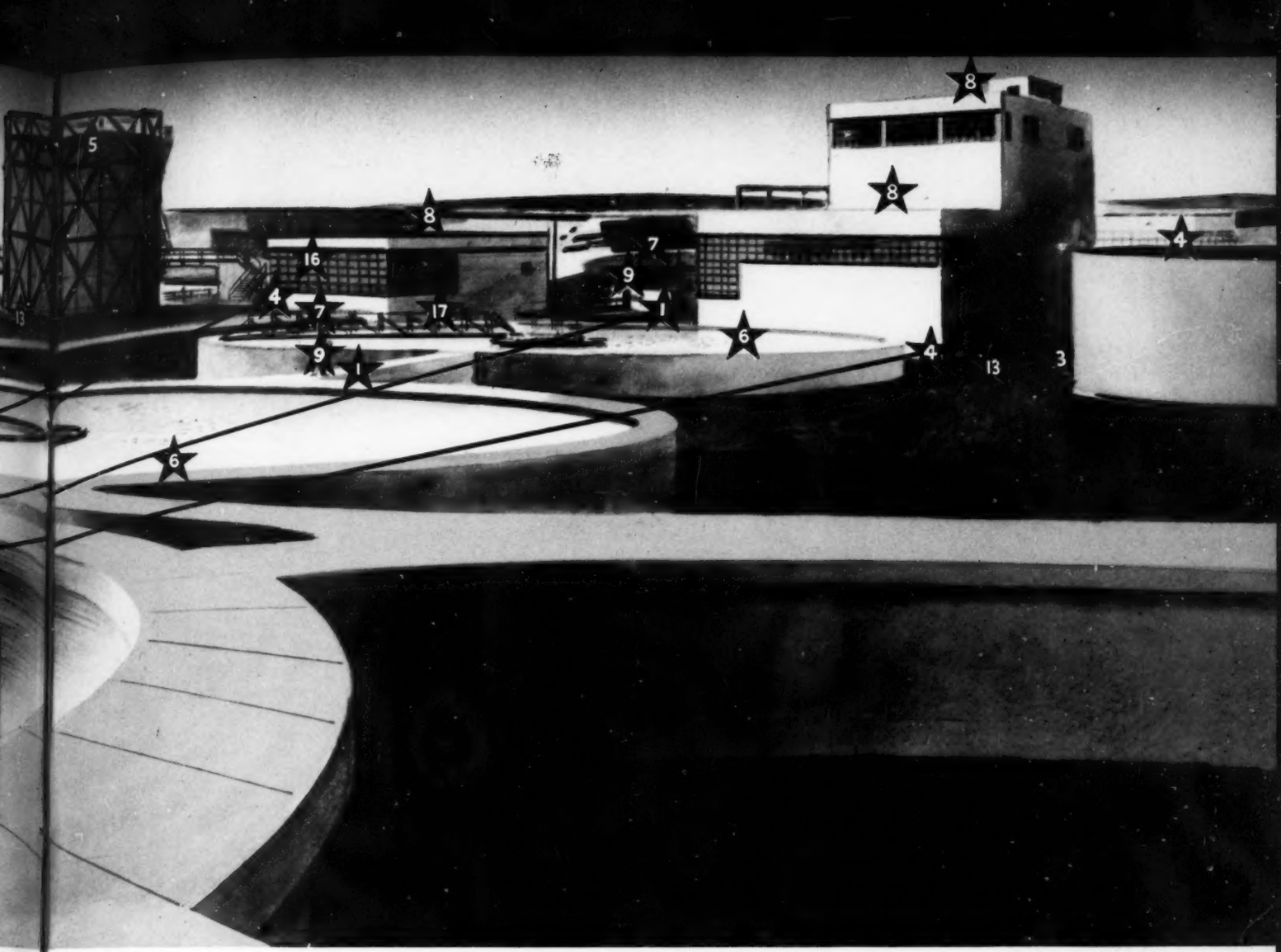


OXIDE BOXES in the hydrogen sulfide removal system at the sewage disposal plant in Fort Atkinson, Wisconsin. This purification system was manufactured by the Western Gas Division.

MANY TYPES and sizes of Sluice Gates, with rising or non-rising stems, are designed and manufactured by Western Gas Division. This photograph shows a group of 42" x 42" motor-operated Western Sluice Gates in use in the interceptor sewers of the Minneapolis-St. Paul District System.



6. Koppers High-Penetration Primer and Seal Coat **7. Floor Stands** **8. Koppers Coal Tar Roofing** **9. D-H-S Bronze Valve Stems, Stem Nuts, Guides, Seats, etc.** **10. Western Pipe** **11. American Hammered Piston Rings** **12. Plate Work** **13. Pressure-treated Timber, Piling, Ties, etc.** **14. Coal** **15. Koppax Bituminous-base Paints** **16. Lumino, Bituminous-base Aluminum Paint** **17. Koppers Semi-Mastic Paints** **18. Tarmac Paving Tar** **19. Fast's Self-aligning Couplings** **20. Western Fire Hydrants**



Drawn for Koppers Company by Alex Ross

4 KOPPERS MEMBRANE Waterproofing and Gasproofing prevent the deterioration of concrete and masonry construction exposed to water, including sludge digestion tanks, foundations, etc.

5 FOR THE STORAGE of recovered gas from the digestion tanks, Western Gas Division builds High Pressure Storage Tanks or Towers and Low Pressure Water-sealed Storage Holders.

KOPPERS DIVISIONS, SUBSIDIARIES AND AFFILIATES

American Hammered Piston Ring Division · Bartlett Hayward Division · Boston Tow Boat Company · Eastern Gas and Fuel Associates · Engineering and Construction Division · Gas and Coke Division · The Koppers Coal Company · Koppers-Rheolaveur Company · The Maryland Drydock Company · Mystic Iron Works · Mystic Steamship Company · New England Coal & Coke Company · Tar and Chemical Division · Western Gas Division · The White Tar Company of New Jersey, Inc. · The Wood Preserving Corporation

KOPPERS

VALVES *be Seated!*

TO good-natured Charlie Elstrodt, every chlorine cylinder valve is leaky until his own "personal" test proves it is tight. Because of Charlie's hard-boiled philosophy, because of the sureness of the compressed air test, mighty few leaky valve seats have gotten by Charlie's inspection in his sixteen years at Mathieson's Niagara Falls plant.

Charlie's job is one of about nineteen different steps in the cleaning, reconditioning and inspection routine through which Mathieson Chlorine cylinders and valves must pass before they are shipped. And in each of these operations it is men like Charlie Elstrodt, men who keep their eyes "glued on the ball", who give Mathieson's cylinder routine the backbone which makes it valuable to you.

Mathieson engineers produce chlorine of a purity second to none; and Mathieson workmen see that you get this pure product in clean, smooth-functioning containers. Couple with this Mathieson's unusual traffic and delivery facilities and their expert technical service and you see why this company presents a chlorine team that is hard to beat.

The MATHIESON ALKALI WORKS (Inc.)
60 East 42nd Street New York, N. Y.

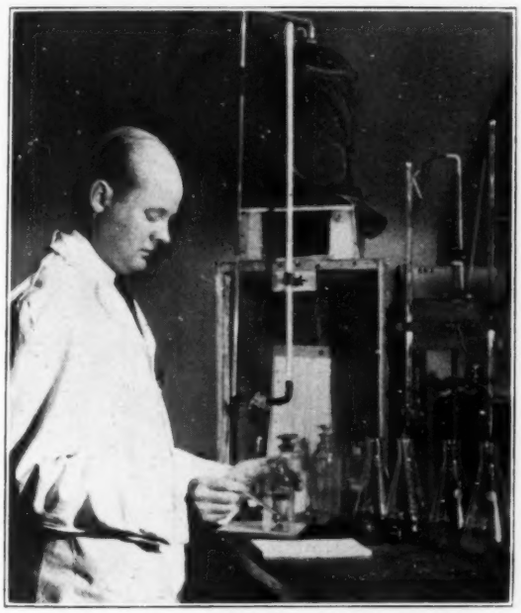
Soda Ash . . . Caustic Soda . . . Bicarbonate of Soda Liquid Chlorine . . . Bleaching Powder . . . HTH and HTH-15 . . . Ammonia, Anhydrous and Aqua PH-Plus (Fused Alkali) . . . Sulphur Chloride CCH (Industrial Hypochlorite) . . . Dry Ice (Carbon Dioxide Ice) . . . Analytical Sodium Chlorite.

MATHIESON CHLORINE

REDUCTION OF BACTERIA IN SEWAGE BY CHLORINATION

By G. E. SYMONS[1], R. W. SIMPSON[2] and WM. L. TORREY[3]

CONCURRENT with the recently published investigations of chlorine demand[5] by the Bird Island Laboratory staff, studies were also made on the bacterial kill effected by sewage chlorination. These investigations were conducted at different seasons of the year on seven of the larger sewers in Buffalo, N. Y. During the course of this experimental work, over 600 determinations were made of the total bacterial content and most probable numbers of Coli-Aerogenes in both raw and chlorinated sewage. The experiments covered a number of variables including temperature of sewage concentration, type of sewage, etc. It is the purpose of this paper to present a summary of these tests.



The Senior Author
(Making the spot-plate test for residual chlorine and chlorine demand.)

Throughout this work, total bacteria were determined after thirty-six hours incubation on agar at 37 deg. C. It was found that this longer time of incubation was helpful in reading the plates on the chlorinated samples. At the end of twenty-four hours, the plates contained too many pin point colonies to be easily counted. Presumptive tests for the Coli-Aerogenes group were made using standard lactotse broth and incubating for 36 hours at 37 deg. C. Thirty-six hour incubation ruled out the extreme slow growers but gave ample time for gas formation. Five tubes were planted in each dilution and four or five dilutions were used on each sample. A better estimation of most probable numbers could be obtained with five tubes than with three tubes. Obviously, since none of the lactose broth tubes showing gas were confirmed, the results do not represent an exact determination of Escherichia coli. However, since all determinations were made under the same conditions, the results may be considered a good estimate of the number of gas formers, most of which may be assumed to be of the Coli-Aerogenes group. For convenience, the density of gas-forming organisms will hereafter be referred to as the most probable number of Coli-Aerogenes.

The Effect of Contact Time on Bacterial Reduction

In studying the effect of contact period, a number of experiments were made on a strong settled sewage in which the contact time was varied from one minute to thirty minutes. The chlorine demand was also determined over the same time intervals, wherein 0.1 p.p.m. of residual chlorine was maintained at each of the respective times. These tests were made at 10 deg. C.

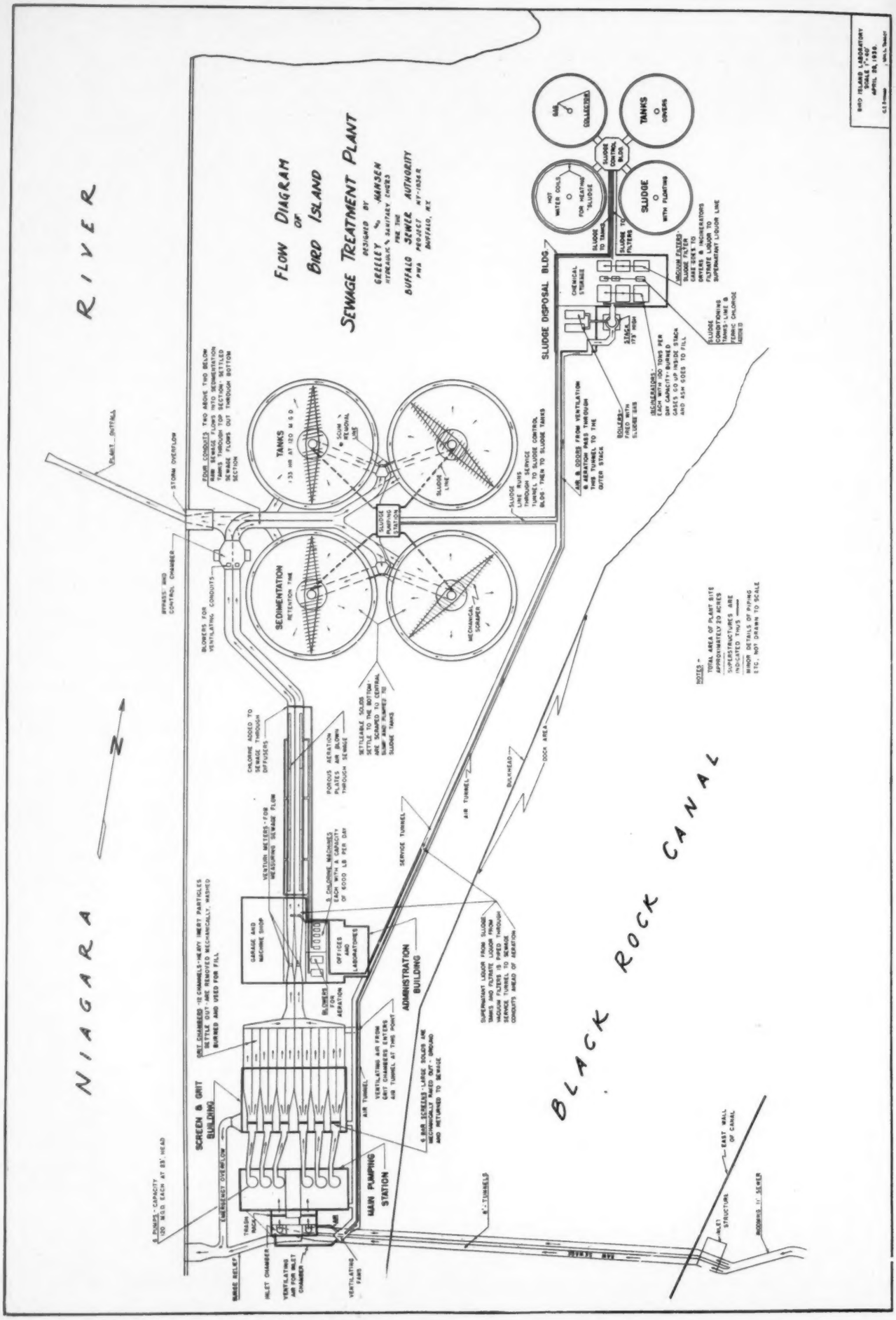
[1]Chief Chemist, [2]Assoc. San. Chemist, [3]Asst. San. Chemist, Buffalo Sewer Authority, Bird Island Laboratory.

This is the second of two campanion articles, which reveal findings in connection with chlorination studies conducted by Dr. Symons and co-workers in the Buffalo Sewer Authority. The first article appeared in our August 1938 issue.

The data has been of considerable valuc to the designing engineers in deciding on plant arrangements, involving capacities of chlorinating equipment, maximum and minimum requirements in terms of chlorine demands; and, in required feed rates from hour to hour for various days of the week and seasons of the year. In consequence, such data has enabled Buffalo's engineers to design for the most effective results and maximum economy in the use of chlorine—a matter of some consequence in continuous chlorination at a plant which is to be the world's largest in point of chlorine consumption for sewage treatment.

The earlier paper dealt with methods and experiences in making chlorine demand tests, studies of chlorine demand variations, the effect of industrial wastes on demand; and, reported on results from a preliminary investigation into the practicability and economy of up-sewer chlorination.

The present paper reports accomplishments with various chlorinating procedures, and sets forth well founded reasons for the decision to adopt pre-chlorination (by single point application) at Buffalo. Such reasons are both fundamentally sound and of high economic importance—particularly so in a plant of the size of that of Buffalo. The value of such studies preliminary to design is thereby clearly established.—Ed.



Flow Diagram of Bird Island Sewage Treatment Plant. Equipped to Feed 30,000 Pounds of Chlorine Per Day to Crude Sewage.

The technique used in the experiments on contact time was as follows: Samples of sewage from two large sewers were collected about 10 a. m. (At this time the sewage strength is slightly above the daily average.) These samples, one of which contained a large proportion of industrial waste (No. 5) and the other strong domestic sewage (No. 6), were mixed in the proportion of 45 per cent and 55 per cent, respectively. This mixture was believed to represent a concentration that might be expected to exist in a large city such as Buffalo.

After mixing, the 15-minute chlorine demand of the sewage was immediately determined. Plantings of dilutions were made in bacterial media for the determination of the total count and Coli-Aerogenes in the raw sewage. The sample of mixed sewage was then allowed to stand in an Imhoff cone for one hour at 10 deg. C. After sedimentation, the settled solids were blocked off with a rubber stopper and the supernatant liquor decanted for testing.

TABLE I.

EFFECT OF SEDIMENTATION ON SEWAGE

1 Hour Settling Period at 10° C.

Item	Unsettled p.p.m.	Settled p.p.m.	Percent. Reduction
Turbidity	218	211	3.2
Color Number	101	98	3.0
Suspended Solids	181	109	39.8[1]
Vol. Susp. Solids	121	78	35.5[1]
Imm. Chlor. Dem.	5.9	5.6	5.1
15 Min. Chlor. Dem.	6.5	6.3	3.1
Bacterial Count/ml.			
Unchlorinated	325,500	215,000	33.9
Chlorinated	3,420	1,510	56.0
Percent. Kill	98.9	99.3	...
B. Coli/ml. (presumptive)			
Unchlorinated	56,800	113,000	—98.9[2]
Chlorinated	1,310	1,280	11.8

[1]Low (see discussion).
[2]Actually a percent increase.

The immediate chlorine demand of the settled sewage was determined and bacterial plantings were also made to determine the effect of sedimentation before chlorination. Chlorine reagent was added to a series of 5 flasks containing 250 ml. of settled sewage. Each succeeding flask in the series received a slightly larger dose than the previous one, so that one of the flasks (preferably the 3rd or 4th) would be so dosed as to just satisfy the 15-minute chlorine demand. The dosage and increments were determined from the previous immediate chlorine demand determination hereafter referred to as the I.C.D.

At the end of 1, 2, 4, 6, 10, 15 and 30 minutes for residual chlorine values, spot tests were made with orthotolodin on the contents of each flask. From the flask showing 0.1 p.p.m. residual chlorine at the respective time, a portion was withdrawn and treated with sodium thiosulphate to remove the excess chlorine. Agar and lactose broth plantings were made of the portion so treated.

Since data were also collected on the original raw unsettled sewage as well as the settled sample, the effect of sedimentation alone was also revealed. Data on this phase of the experiments are shown in Table I.

The low removal of suspended solids may be attributed to the use of Imhoff cones, wherein part of the settled solids collected on the sloping sides. These were consequently washed out when the sewage was poured off on the settled solids blocked off in the tip of the cone.

There are several observations to be made from these data:

(1) One hour of sedimentation resulted in a removal of 40 per cent of the suspended solids, but decreased the 15-minute chlorine demand by only 3 per cent.

(2) The total bacteria were reduced 34 per cent as the result of one hour of sedimentation, without chlorination.

(3) On the other hand, the gas-forming organisms (here called Coli-Aerogenes) practically doubled during the settling time, when the crude sewage was not chlorinated.

(4) The per cent kill was but very little higher in the chlorinated settled sewage than in the chlorinated crude sewage. The final Coli-Aerogenes content (gas formers) was practically the same in both cases.

Since there was so little lowering of chlorine demand as the result of sedimentation, and since the bacterial content of the settled sewage was quite high, it was believed that the results with various contact periods on settled sewage may also apply generally to crude sewage which is chlorinated and thereafter settled. In the experiments on contact periods, both the per cent kill of bacteria and the per cent satisfaction of the ultimate chlorine demand were determined at the respective time intervals. The average results of the series of experiments on contact time are shown in Table II:

Five observations may be made from these data:

(1) Fifteen-minute contact time was sufficient for the complete satisfaction of the chlorine demand.

(2) During contact periods of less than 15 minutes, the Coli-Aerogenes appeared to be slightly more resistant to chlorine than were other forms of bacteria, i.e., the Coli-Aerogenes kill lagged behind the total kill.

(3) Fifteen-minute contact time removed practically 99 per cent of the Coli-Aerogenes and total bacteria but, with a residual chlorine contact of 0.1 p.p.m., less than 15 minutes' contact was not sufficient.

(4) The chlorine demand was largely satisfied during the first two minutes but the bacterial kill lagged behind the per cent satisfaction of the chlorine demand.

TABLE II

BACTERIAL REDUCTION AT VARIOUS CONTACT TIMES

Contact Time	C. D.* p.p.m.	% of 15 Min. C. D.	Bact./ml. Agar 37° C.	% Removal	M. P. N. E. Coli/ml.	% Removal	% of Bact. Removed/min.	% of E. Coli Removed/min.
Untreated settled sew.	...	...	215,045	...	113,000	...	....	....
0 min. immed. C. D.	5.6	89.0	.....	...	.....	...	....	....
1 min.	5.6	89.0	54,110	74.4	61,530	49.1	74.4	49.1
2 min.	5.7	90.1	33,395	84.3	33,900	70.0	9.9	20.9
4 min.	5.8	92.9	17,125	92.0	20,720	81.7	4.0	5.9
6 min.	5.9	94.8	8,135	96.2	9,450	91.6	2.1	4.9
10 min.	6.0	96.5	2,830	98.7	7,110	93.7	0.62	0.53
15 min.	6.3	100	1,506	99.3	1,280	98.9	0.12	1.04
30 min.	6.35†	101.0	767	99.6	205	99.8	0.02	0.06

*Residual 0.1 p.p.m. by B. I. L. method.
†Residual 0.05 p.p.m. by B. I. L. method.

(5) There was but little further uptake of chlorine and little additional bacterial kill between 15 and 30 minutes. However, the kill approached 100 per cent with increased contact time, thus indicating the value of longer contact periods when residual chlorine is low or absent.

Bearing in mind that different techniques of chlorine demand tests were used, these data may be compared to the findings of other observers:

Observer	Contact Time	Residual Cl_2 p.p.m.	Per cent kill Coli
Tiedeman[6]	5 min.	0.2—0.6	"sufficient"
Rudolfs & Gehm[2].....	6 min.	+	95.0
Bird Island Laboratory	6 min.	0.1	91.6
Scott & Pool[3].....	10 min.	0.3	"effective disinfection"
Rudolfs & Gehm.....	10 min.	+	98.0
Bird Island Laboratory	10 min.	0.1	93.7
Scott & Pool[3].....	15 min.	+	"more effective"
Bird Island Laboratory	15 min.	0.1	98.9

One curious observation is that there appears to be a greater per minute per cent kill of Coli-Aerogenes between 10 and 15 minutes than between 6 and 10 minutes. To account for this, there is no apparent explanation. However, it has been suggested that the cell structure is gradually being broken down in the period of reaction between the absorbed chlorine and the proteins of the bacterial cell.

Bacterial Reductions by Chlorination of Sewages

Samples of each sewer under investigation were collected every 15 minutes when flow gagings were made. At the end of each two-hour period, these samples were transported to the laboratory where they were composited according to flow. The average age of the composited sample was less than 1½ hours.

Agar plates and lactose broth tubes were immediately planted with dilutions of the raw sewage. Five equal portions of raw sewage were treated with chlorine in graded amounts as indicated by Immediate Chlorine Demand (I.C.D.) tests. At the end of 15 minutes' contact the residual chlorine was determined. That sample showing 0.1 p.p.m. residual chlorine by ortho-tolidine on a spot plate was picked as representing the chlorine demand of the sewage. This Bird Island Laboratory method of determining chlorine demand has been completely described in the Sewage Works Journal[4] and the method of sampling and analytical results have been reported in an earlier article in this magazine.[5] Chlorine demand results by this method were found to be, in general, 10 per cent less than by the standard method.

The sample picked as having the proper chlorine dosage to completely satisfy the demand after 15 minutes' contact, was set aside for an additional 25 minutes. At the end of this period (total contact time 40 minutes), plantings and dilutions were made immediately in agar and lactose broth.

The choice of a total contact time of 40 minutes followed the studies on the effect of contact time. It was chosen primarily, however, because it represents one-half of the average dry weather detention time that will exist in the sedimentation tanks of the Buffalo Sewage Treatment Plant. Chlorination in this plant will take place before sedimentation, and 40 minutes' contact appeared to be reasonable. This contact time also fitted well into the routine of the 2-hour samples. No thiosulphate was added to the chlorinated samples after 40 minutes' contact, because after such contact neutralization had been found to have no effect on the results. There was at least .05 p.p.m. residual chlorine present at the end of the contact time. Total count and gas formers in lactose broth were read at the end of 36 hours. Since, in the early experiments, the sampling represented proportionate flow, over 2-hour periods, an average bacterial analysis for the day could easily be determined from such data.

In these early experiments, bacterial tests were made on each two-hour sample. These studies indicated that the daily average concentration of bacteria occurred, generally, between 8 and 10 in the morning, and between 8 and 10 in the evening, except in cold weather. Therefore, in the summer studies in 1937, tests were made only on the samples collected during these hours.

Table III presents descriptive data on the various sewers studied, showing that different concentrations and types of sewage were investigated:

TABLE III

DESCRIPTION OF SEWERS INVESTIGATED

All data are Averages of 1936-1937 Studies.

Sewer No.	Area Acres	Trib. % of City	Pop. 1,000	Trib. % of City	—Flow— M.G.D.	% of City[4]	—Pop. Equiv.— B.O.D.[1] 1,000	C. D.[2] 1,000
No. 1...	2,100	9.8	40	6.9	9.0	8.2	55.3	63
No. 2...	401	2.0	2	0.3	4.3	4.0	96.5	217
No. 3...	1,349	6.3	53	9.1	9.6	8.8	117.0	194
No. 4...	550	2.6	32	5.5	6.3	5.7	83.0	207
No. 5[3]..	7,325	34.3	240	41.1	46.4	43.6	401.0	730
No. 6...	5,340	25.0	143	24.5	25.3	23.9	206.0	199

[1]0.17 lbs./cap./day.
[2]0.005 lbs./cap./day.
[3]Includes sewers Nos. 1-2-3-4.
[4]Estimated.

Table IV is the summary of the bacterial data collected in these studies. These data show not only the numbers of bacteria per ml. but also the Quantity Units (Q.U.), which are $\frac{\text{Bacteria per ml.} \times \text{C. F. S.}}{1000}$.

Table IV shows that the experiments covered different temperatures, and sewages of different character and concentrations. It is interesting to note, therefore, that with fairly low chlorine demands (a residual of only 0.1 p.p.m. at 15 minutes), and a 40-minute total contact period, the average kill was 99.8 per cent for Coli-Aerogenes and 99.6 per cent for total count. In only three instances was the kill even slightly below 99 per cent.

In the studies on contact time (Table II), it appeared that Coli-Aerogenes were slightly more resistant than the general run of sewage bacteria. The data in Table IV indicate that after 40 minutes' contact the per cent removal of Coli was very slightly higher than that of the total bacteria.

These summarized data do not present the entire picture of the experimental results. In Table V are presented the average data for the two-hourly samples on sewer No. 5 in November, 1936, at an average temperature of 12 deg. C. and, for comparison, the data on the same sewer for February, 1937, at an average temperature of 8.2 deg. C.

An Anomaly

In the cold weather studies in February (Table V), a peculiar situation appeared. From 9 p. m. until 7 a. m., the per cent removal of Coli-Aerogenes dropped below 99 per cent with the lowest removal (74.2 per cent) occurring at 5 to 7 a. m. The per cent removal increased thereafter to 11 a. m. when it went above 99 per cent. There was a similar but less apparent change in removal

TABLE IV
AVERAGE BACTERIAL RESULTS ON UNCHLORINATED AND CHLORINATED SEWAGE

TIME OF STUDY	SEWER NO.	NO OF SAMPLES ANALYZED	AVG TEMP °C.	AVG C.D. p.p.m.	M.P.N. OF COLI-AEROGENES					TOTAL COUNT				
					UNCHLORINATED		CHLORINATED		PERCENT REMOVAL	UNCHLORINATED		CHLORINATED		PERCENT REMOVAL
					PER ML.	Q.U.	PER ML	Q.U.		PER ML	Q.U.	PER ML.	Q.U.	
SEPT '36	#5	24	23.1	10.9	348,300	25,600	660	48.7	99.81	2,335,000	169,900	23,260	1,566	98.58
NOV. '36	#5	84	17.1	10.2	120,100	8,800	170	12.3	99.86	177,000	12,500	670	46	99.63
FEB. '37	#5	84	8.2	7.3	45,900	3,100	970	57.5	98.13	559,000	36,800	2,790	181	99.51
AUG. '37	#5	4	24.2	8.1	175,000	13,300	20	1.8	99.99	2,760,000	210,000	1,770	129	99.94
FEB. '37	#6	24	9.6	3.3	70,800	3,200	590	26.2	99.19	392,000	17,800	4,670	213	98.81
JULY '37	#6	16	20.9	4.2	102,300	2,900	60	1.8	99.94	1,120,000	34,300	1,150	35	99.91
JULY '37	#1	16	23.0	3.6	134,200	2,100	110	2.2	99.90	1,551,000	24,100	8,220	132	99.46
JULY '37	#2	12	26.0	28.4	49,800	380	80	0.5	99.86	1,060,000	7,900	2,260	17	99.78
JULY '37	#3	12	22.1	10.5	1,973,000	2,900	90	1.3	99.96	1,180,000	17,400	710	10	99.94
AUG. '37	#4	4	23.8	13.4	26,800	300	30	0.3	99.90	2,470,000	24,100	920	9	99.96
						6,300		15.3	99.76		55,500		234	99.58

of total bacteria. Possibly the lower temperature of the sewage at those hours served to make the bacteriacidal reaction, with such low residuals, less effective on the coli group. It will be noted that the chlorine demand was at a minimum during the same period.

Regardless of these low per cent kills of Coli in the early morning hours, the weighted daily average per cent removal was but slightly affected. This was true because the Quantity Units (Q.U.) of Coli-Aerogenes at those hours was a very small part of the total for the day.

Effect of Dilution on the Regrowth of Bacteria in Chlorinated and Settled Sewage

Some work[2] has been done on the regrowth of bacteria in chlorinated sewage at 37 deg. C. and studies[1]

TABLE V
TWO-HOUR ANALYSES—SEWER NO. 5—7-DAY AVERAGE

HOUR	FLOW C.F.S.	TEMP. °C.	CHLORINE DEMAND		M.P.N. OF COLI-AEROGENES					TOTAL COUNT				
			p.p.m.	RATE-POUNDS PER DAY	UNCHLORINATED		CHLOR.-40 MIN. CON.		PER CENT REMOVAL	UNCHLORINATED		CHLOR.-40 MIN. CON.		PER CENT REMOVAL
					PER ML.	Q.U.	PER ML.	Q.U.		PER ML.	Q.U.	PER ML.	Q.U.	
NOVEMBER 1936 RESULTS														
7-9 A.	66.55	11.7	10.2	3650	24,700	1640	146	9.8	99.40	107,600	7,160	410	27.4	99.40
9-11	74.91	12.7	12.2	4910	167,400	12,540	246	18.4	99.45	177,200	13,280	510	43.5	99.60
11-1 P.	77.89	12.5	18.4	7720	228,800	17,830	205	16.0	99.66	213,000	16,600	500	38.9	99.68
1-3	78.33	12.8	11.2	4730	212,100	16,820	173	13.6	99.63	270,600	21,200	480	37.7	99.73
3-5	76.55	12.3	15.6	6420	171,100	13,100	147	11.2	99.75	197,300	15,110	360	27.9	99.76
5-7	74.68	12.7	11.8	4760	103,100	7,700	125	9.4	99.73	75,800	5,700	200	15.2	99.67
7-9	73.44	12.7	8.9	3540	69,700	5,120	150	11.0	99.63	103,800	7,600	740	54.3	99.56
9-11	71.03*	11.9	8.2	3140	203,600	14,460	468	33.2	99.06	85,300	6,060	350	25.1	99.52
11-1 A	68.45	11.9	6.5	2400	68,300	4,670	77	5.3	99.73	202,300	13,800	830	57.0	99.45
1-3	65.21	11.5	6.4	2230	95,000	6,200	61	4.0	99.83	277,500	18,100	1770	115.1	99.48
3-5	62.04	11.7	6.6	2200	44,400	2,760	102	6.3	99.81	307,400	19,100	940	58.6	99.52
5-7	60.99	11.5	6.5	2150	52,800	3,220	159	9.7	99.37	107,100	6,500	830	50.6	99.01
AVG.	70.84	12.2	10.2	3990	120,100	8,850	172	12.3	99.86	177,100	12,520	670	45.9	99.63
FEBRUARY 1937 RESULTS														
7-9 A	41.64	6.9	5.5	1950	24,800	1610	3140	195.9	87.84	154,300	9,350	3610	248.1	97.35
9-11	44.76	7.5	7.7	2860	57,600	2570	540	37.2	98.55	294,300	20,130	610	41.9	99.79
11-1 P	46.92	8.2	11.4	4410	69,900	5020	150	10.7	99.79	865,000	62,130	2940	215.9	99.66
1-3	46.44	8.6	12.4	4820	92,100	7020	500	35.5	99.50	866,200	62,370	2490	179.9	99.71
3-5	45.16	8.5	10.4	3950	61,600	4280	130	8.8	99.80	1,024,300	71,670	1840	127.3	99.82
5-7	43.92	8.2	11.3	4180	62,600	4250	240	16.4	99.61	575,800	39,400	2490	168.8	99.57
7-9	42.84	8.3	6.6	2390	48,600	2950	120	7.8	99.74	994,300	63,500	2730	180.2	99.73
9-11	41.52	8.5	5.2	1810	47,700	3040	600	37.9	98.76	1,057,000	57,700	2740	175.6	99.69
11-1 A	40.32	8.4	4.2	1420	39,500	2460	940	58.0	97.64	313,700	19,700	2750	169.6	99.14
1-3	39.00	8.3	4.1	1370	26,900	1610	1380	82.4	94.89	214,200	12,200	3480	208.3	98.29
3-5	37.56	8.4	4.0	1270	29,000	1690	1930	112.3	93.34	167,100	9,650	3900	226.1	97.66
5-7	38.28	8.4	4.3	1370	5,700	340	2070	84.8	74.24	188,600	11,040	3950	226.2	97.95
AVG.	42.36	8.2	7.3	2650	48,900	3070	970	57.5	98.13	559,000	36,840	2790	180.7	99.51

have been made by the New York State Department of Health Laboratories on regrowth of Coli in a small stream receiving chlorinated sewage. It did not seem justified to assume that the data of these studies would be applicable to a situation in which a sewage treatment plant discharges a chlorinated effluent into a large volume of relatively pure diluting water.

At Buffalo, laboratory and field studies on sewers and the Niagara River indicated that a dilution of sewage with river water, of greater than 1 to 320, exists. It also appeared from the stream pollution studies that the number of Coli-Aerogenes in the polluted zone of the Niagara River increased approximately five times over the number calculated to be introduced with the sewage.

The effect of this large dilution on chlorinated and unchlorinated sewage was studied in the laboratory, experimentally, at two different temperatures. In the first set of experiments the temperature was 8 to 9 deg. C., and in the second series the temperature was 24 to 26 deg. C.

The technique employed in the experiments was as follows: Two two-gallon bottles were placed in a water bath maintained at constant temperature. Sewage collected from two trunk sewers (Nos. 5 and 6) was mixed. Plantings were made immediately in bacterial media. The chlorine demand was also determined. Twenty (20) ml. of the unchlorinated sewage were added to one (1) liter of lake water in one of the two bottles. During a period of two hours, with constant stirring, an additional 5.4 liters of lake water were added to the bottle in increments, thereby producing a dilution of 1 to 320.

One liter of raw sewage was chlorinated to satisfy the 15-minute demand and allowed to settle for one hour. The supernatant liquor was siphoned off and mixed. Tubes and plates were planted for Coli-Aerogenes and total count determinations on this chlorinated and settled sewage. Twenty (20) ml. of this chlorinated and settled sewage were added to one liter of lake water and made up to 6400 ml. during a period of two hours as in the case of the crude sewage. This gradual dilution was made to simulate conditions of dilution in the Niagara River. Every two hours after the dilution was completed in each bottle, a portion was withdrawn for the determination of total count and Coli-Aerogenes. The contents of each bottle were stirred constantly at a velocity equivalent to that in the Niagara River (i.e., approximately 1.5 miles per hour).

The bacterial count and Coli-Aerogenes per ml. were determined on the lake water and sewage. From these data, a weighted average content per ml. in the original mixture of sewage plus dilution water was calculated. A comparison of this weighted average with the two-hourly analyses thereafter shows the effect of dilution on bacterial growth and regrowth.

The data are shown in Table VI. They indicate that regardless of temperature the bacteria (and to a lesser degree the Coli-Aerogenes) in unchlorinated sewage followed growth cycles when diluted with a large volume of water. During a twenty-four period, the bacterial population remained relatively large.

When pre-chlorinated settled sewage was diluted with a large volume of water, the bacterial numbers increased somewhat for a short time but thereafter decreased to a relatively low level. This was particularly true of Coli-Aerogenes, as shown.

With sufficient dilution it seems that natural enemies tend to keep the bacterial population small if relatively few are introduced into a large body of diluting water. This condition appeared to prevail even though there was a large supply of organic matter present to serve as bacterial food.

Summary and Conclusions

The following conclusions have been drawn from these experimental studies:

(1) Sedimentation at 10° C. which affected 40 per cent removal of suspended solids in strong sewage reduced the chlorine demand by only 3 per cent and the total bacterial count by 34 per cent, whereas, the number of Coli-Aerogenes (gas formers) present practically doubled.

(2) A 15-minute contact period is sufficient to completely satisfy the chlorine demand of sewage. A residual chlorine content of 0.1 p.p.m. at 15 minutes will effect approximately 99 per cent kill of bacteria in *either settled or unsettled sewage.*

(3) A contact time of less than 15 minutes produces a correspondingly lower per cent satisfaction of chlorine demand. The bacterial kill at the lesser contact times lags behind the per cent satisfaction of the demand.

(4) Thirty to forty-minute contact periods (with a residual chlorine content of 0.1 p.p.m. after 15 minutes) produce practically no increase in chlorine demand above that of 15 minutes, and effect a bacterial kill of 99.6 to 99.8 per cent regardless of temperature, concentra-

TABLE VI

BACTERIAL CONTENT IN UNCHLORINATED AND CHLORINATED SEWAGE AFTER DILUTION*

	Total Count/ml.				M.P.N. Coli-Aerogenes/ml.			
	8-9° C.		24-26° C.		8-9° C.		24-26° C.	
Sample	Unchlor.	Chlor.	Unchlor.	Chlor.	Unchlor.	Chlor.	Unchlor.	Chlor.
Lake water	101	101	2,990	2,990	1.27	1.27	2.5	2.5
Sewage	253,000	18,500	2,750,000	850	33,500	1,320	156,000	63.0
Weighted avg. of mix	892	163	116,000	2,980	106	5.4	501	2.7
Hour—								
2	654	225	5,880	2,740	87	4.3	855	8.8
4	2,370	105	7,680	2,800	59	5.8	276	16.0
6	350	130	5,460	4,700	59	3.4	240	1.4
8	555	89	12,600	6,590	58	1.6	69	1.6
10	305	58	33,100	6,840	131	1.9	80	0.6
12	198	125	65,500	22,900	58	1.4	127	1.4
14	335	47	124,000	6,200	93	1.0	110	0.8
16	323	42	111,000	8,750	47	0.7	75	1.3
18	343	55	108,000	18,800	68	0.9	192	0.9
20	327	64	180,000	28,800	26	0.2	335	0.4
22	453	29	61,400	5,350	131	0.3	180	0.6
24	293	40	50,900	26,500	48	0.3	192	1.2

*Dilution to simulate that occurring at Buffalo, viz., 319 volumes of Lake Erie water to 1 volume of sewage.

tion of sewage, chlorine demand, or the number of bacteria present.

(5) When pre-chlorinated settled sewage is added to a large volume of untreated lake water, relatively no regrowth of sewage bacteria is observed.

Acknowledgment.—The authors wish to express their appreciation to G. E. Terhoeven (now of the National Anilene & Chemical Co.) and J. E. Januale, J. J. McGuire and C. G. Ketcham, members of the Bird Island Laboratory staff for their assistance in the collection of samples, analytical determinations and compilation of results.

BIBLIOGRAPHY

1. Gilcreas, F. W. (private communication).
2. Rudolfs and Gehm. N. J. Agr. Exp. Sta. Bull. No. 601, March, 1936.
3. Scott and Pool. Eng. News Record—99, 1033, 1927.
4. Symons, G. E. Sew. Wks. Journal—9, 569-78, 1937.
5. Symons, Terhoeven & Torrey. Water Works & Sewerage—85, 789, August, 1938.
6. Tiedeman, D. V. D. Eng. News Rec.—98, 944-48, 1927.

▼

METER RESEARCH

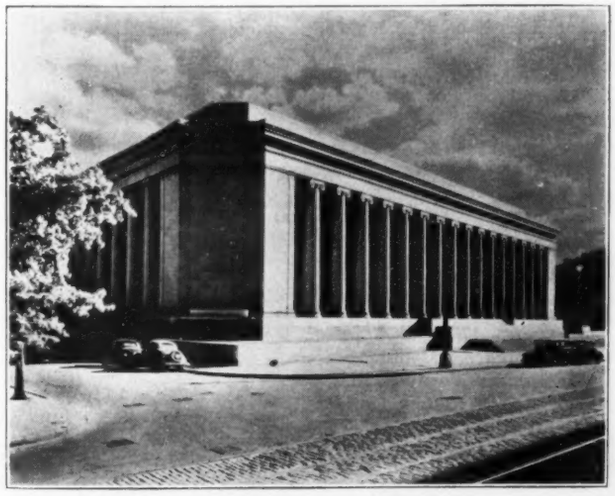
Fellowship at Mellon Institute Established by Pittsburgh Meter Co.

The new building here pictured at Mellon Institute will house, amongst others, a laboratory devoted to research direct toward production of improved meters for water and other liquids.

Dr. E. R. Weidelin, Director of Mellon Institute, recently announced the establishment of a new Industrial Fellowship on "Meterization and Meter Technology," the donor of the fellowship being the Pittsburgh-Equitable Meter Co.

One of the first projects planned is that of attempting to adapt synthetic resins and plastics as materials to be used in constructing improved meters and meter parts. Dr. R. L. Wakeman, who has been appointed to the new Meter Fellowship, holds a Ph.D. degree (1930) from Mass. Inst. Technology, studied abroad and returned to an industrial position. He joined the Mellon Institute staff in 1935, and in recent years has come to be considered an authority on synthetic resins and plastics.

Concerning the new meter fellowship, Col. Willard R. Rockwell, president of the Pittsburgh Equitable Meter Co., commented that his company has always maintained, and will continue to maintain, completely equipped and staffed chemical and physical laboratories; constantly searching for better metering methods and materials. However, added this far-sighted executive—"The scientific and technological problems involved in producing *something better* may require intense research by scientists who can devote their entire time and energy to solution in a manner which cannot be expected from laboratories dealing with daily practical problems."



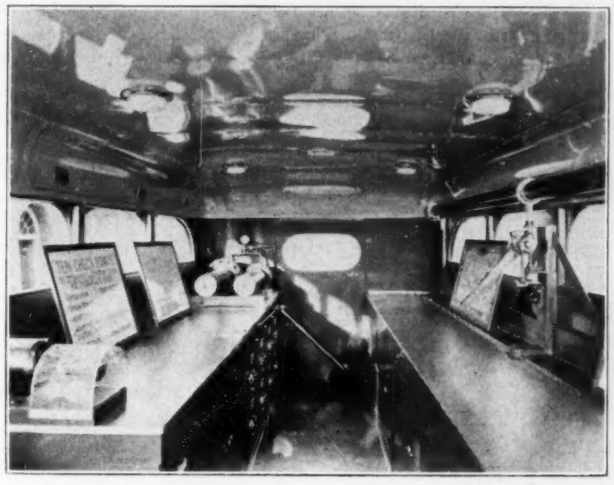
New Building at Mellon Institute

▼

"CAST-IRON CRUISER"

Otherwise, ACIPCO'S Display Truck

Cruising around the United States, for the purpose of demonstrating cast-iron pipe and fittings on a planned schedule, is the new Cast-Iron Pipe Display Truck of the American Cast Iron Pipe Company, the home port of which is Birmingham, Alabama.



Glistening Work Benches—Acipco's Display Truck

This novel display truck is fully equipped to demonstrate the many advances made in recent years in the art of manufacture of cast-iron pipes and fittings, and the perfection of improved mechanical pipe joints. In addition, it is especially equipped to demonstrate the specific qualities of Acipco's Mono-Cast Centrifugal Pipe, spun in green sand molds; Acipco's new corrosion proofed "Enameline" pipe; also, Acipco's flexible and tenacious mechanical joints.

The truck will take cast-iron pipe news and technical advances to the very door of all important pipe users and engineers. It will also make calls at engineering colleges for the purpose of showing students "what's what" about cast-iron pipe. Engineering clubs finding it of interest may arrange through Acipco headquarters, at Birmingham, to have the truck at a convenient location for one of their meetings. The name of Acipco's magazine is *"Pipe Progress."* Their "Cast-Iron Cruiser" represents more of the same.

▼

SCHROEPFER MADE CHIEF OF TWIN CITIES SEWERAGE SYSTEM

George J. Schroepfer, for ten years associated with the planning and construction of the Twin Cities sewage disposal system as assistant engineer, recently was appointed Chief Engineer and Superintendent of the new $16,000,000 Minneapolis-St. Paul Sanitary District sewage disposal system.

Geo. J. Schroepfer

VENTURI METERING EQUIPMENT IN MODERN SEWAGE WORKS

By ROBERT T. REGESTER
Whitman, Requardt and Smith, Engineers, Baltimore, Md.

The Author

VENTURI meters and their related devices are recognized by sanitary engineers as invaluable aids to the efficient operation of the modern sewage treatment plant. Flow measurement furnishes an essential part of the information required for the intelligent control of a treatment process. It is complemented by periodic chemical analyses of the sewage before treatment and after each step of the process. Together, these data indicate the quantity and quality of the raw material (sewage); the by-products (sludge and gas); and the finished product (treated effluent).

In general, the extent to which Venturi metering equipment is provided in sewage works increases with both the capacity of the plant and the completeness, or degree, of treatment to be accomplished. Capacity, expressed in million gallons per day of sewage is primarily a direct function of the population served. More treatment units, or tanks, to be metered are required for each step of the process as the capacity of the works is increased beyond certain limits. The degree of treatment required depends upon many factors, especially those pertaining to the body of water into which treated effluent is to be discharged. In accordance with such requirements, communities provide treatment works for either primary, intermediate or complete treatment of their sewage. Additional steps in the process are necessary as the required completeness of treatment increases.

In many large American cities, where sewage works have been constructed and enlarged within the past ten years, local conditions have warranted the highest degree of treatment. Accordingly, works of the activated sludge type were built by New York, Chicago, Cleveland, Milwaukee, Columbus and other cities. At Baltimore an addition of this type has just been designed. All of these large works are extensively metered—some to a greater degree than others. The general arrangement of the works with respect to flow distribution, the desired flexibility of operation and economic limitations, all have been controlling elements in the extent of metering. Then, too, designers naturally differ in their opinions of these matters.

"Complete" Metering

There is a decided trend toward "complete" metering —especially for works of the activated sludge type. This type of works, providing complete treatment together with the pumping of raw sewage, offers the most numerous applications for metering equipment. The trend is justified from the standpoints of both proper process functioning and operating economy. This tendency is reflected in several more recent designs where provision is made for the parallel operation of similar tanks under different flow conditions. The best combination of variable relationships thereby can be determined. Of course, operation in this manner is intended to be periodic, as the occasion demands, rather than regular. By such means, unfavorable influences can be observed and closer control effected. The works can serve the role of a full-scale pilot plant. In very large works, batteries of similar tanks can take the place of individual tanks so arranged.

Activated sludge works are extensively mechanized and electrified. They present a somewhat complicated arrangement because of the multiplicity of treatment units and process steps. The diagrammatic arrangement here shown serves to illustrate the application of metering equipment for both measurement and regulation of flows to the principal units. This typical layout assumes groups of four units arranged for maximum flexiblity and control.

Measurement of Raw Sewage

It is often necessary for raw sewage to be pumped from the outfall sewer to such elevation as will produce gravity flow through the entire plant. Individual centrifugal pumps are metered so that periodical checks can be made on the efficiencies of the respective units. These meters may be equipped with only portable manometers, calibrated directly in rate-of-flow units. On the other hand, individual indicating-recording instruments would show at a glance the immediate performance and would also provide a record of past performance for each pump. This latter scheme is not uncommon in pumping station design.

It is most desirable to provide means for readily ascertaining the total sewage flow to the works. This can be accomplished either by summation (electrically and continuously) of the rates of flow through the individual pump meters, or by providing a separate master sewage meter. In the case of divided flow after pumping, to suit an immediate or future duplicate arrangement of plant, a separate master meter should be provided to serve each half of the layout.

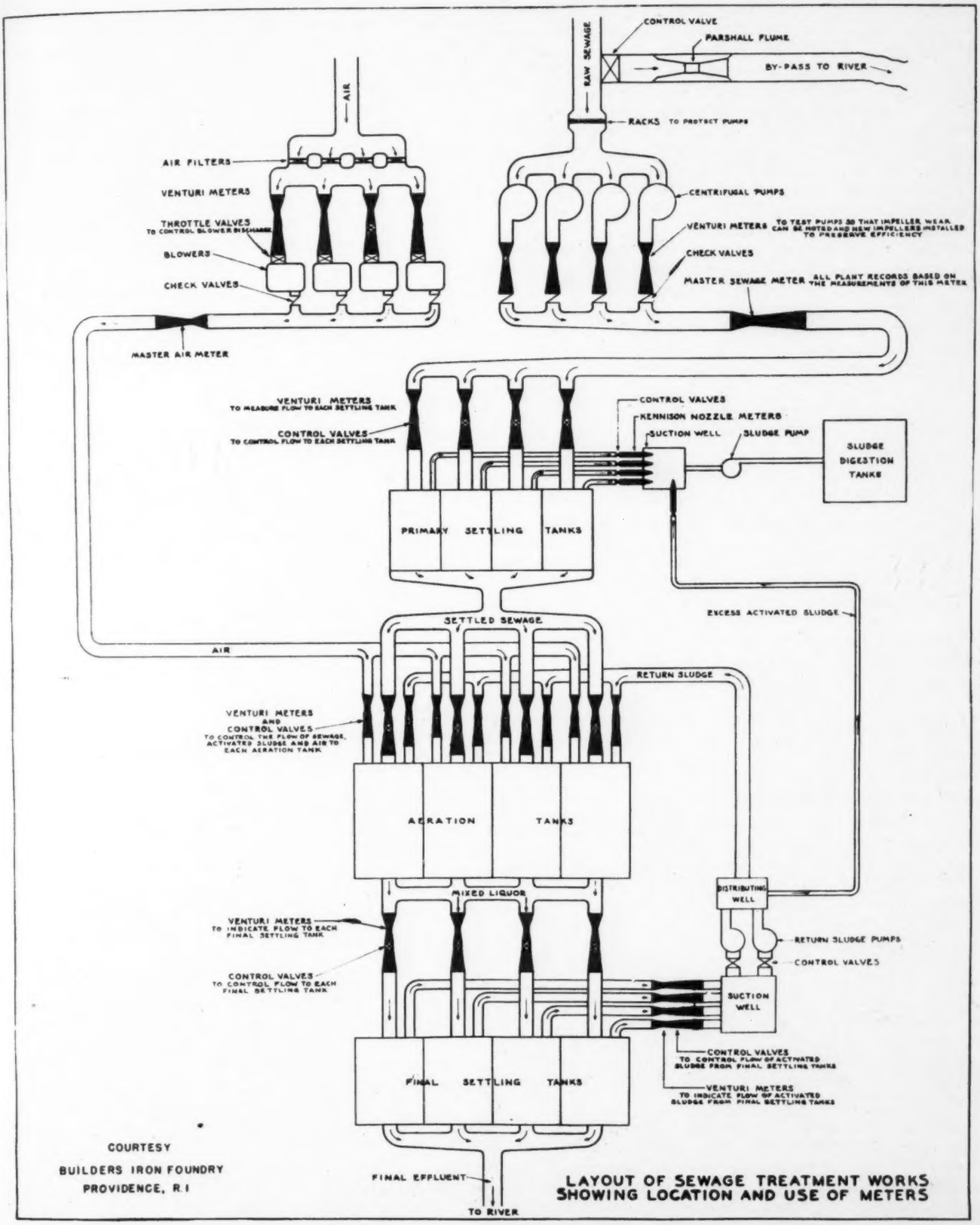
In a large plant it is convenient to have an indication of the total sewage rate of flow at several strategic locations other than at the sewage pumping station. Electrically-operated transmitters and indicators are now used to repeat the summation or master meter readings to such remote points. Suitable illuminated master-sewage dials can thus be provided in the blower house, the operating gallery and, if desired, in the administration building.

Primary Settling Tank Control

Primary settling tanks are used for the removal of such suspended solids as will readily settle from the sewage when it is flowing at a very low velocity. The deposited material, known as raw sludge, is collected mechanically and removed continuously.

It is desirable to have individual settling tanks perform equal duty. As a means of equalizing flows to the units of a battery of these tanks, individual meters

with regulating valves can be advantageously used. The valve can be of one of several types, either hydraulically or electrically operated, inserted in the recovery tube of the meter for each tank. This permits the use of a smaller size valve. To minimize the effect upon meter accuracy, the valve should be placed at least two throat-diameters downstream from the throat pressure chamber. The indicating instruments and valve controls can be arranged, for operating convenience, on a control table or panel.


CONTROL VALVE
PARSHALL FLUME
RAW SEWAGE
BY-PASS TO RIVER
RACKS TO PROTECT PUMPS
AIR
AIR FILTERS
VENTURI METERS
THROTTLE VALVES TO CONTROL BLOWER DISCHARGE
BLOWERS
CHECK VALVES
CENTRIFUGAL PUMPS
VENTURI METERS TO TEST PUMPS SO THAT IMPELLER WEAR CAN BE NOTED AND NEW IMPELLERS INSTALLED TO PRESERVE EFFICIENCY
CHECK VALVES
MASTER SEWAGE METER ALL PLANT RECORDS BASED ON THE MEASUREMENTS OF THIS METER
MASTER AIR METER
VENTURI METERS TO MEASURE FLOW TO EACH SETTLING TANK
CONTROL VALVES TO CONTROL FLOW TO EACH SETTLING TANK
CONTROL VALVES
KENNISON NOZZLE METERS
SUCTION WELL
SLUDGE PUMP
SLUDGE DIGESTION TANKS
PRIMARY SETTLING TANKS
EXCESS ACTIVATED SLUDGE
SETTLED SEWAGE
AIR
RETURN SLUDGE
VENTURI METERS AND CONTROL VALVES TO CONTROL THE FLOW OF SEWAGE, ACTIVATED SLUDGE AND AIR TO EACH AERATION TANK
AERATION TANKS
MIXED LIQUOR
DISTRIBUTING WELL
VENTURI METERS TO INDICATE FLOW TO EACH FINAL SETTLING TANK
CONTROL VALVES TO CONTROL FLOW TO EACH FINAL SETTLING TANK
RETURN SLUDGE PUMPS
CONTROL VALVES
SUCTION WELL
CONTROL VALVES TO CONTROL FLOW OF ACTIVATED SLUDGE FROM FINAL SETTLING TANKS
VENTURI METERS TO INDICATE FLOW OF ACTIVATED SLUDGE FROM FINAL SETTLING TANKS
FINAL SETTLING TANKS
COURTESY
BUILDERS IRON FOUNDRY
PROVIDENCE, R.I.
FINAL EFFLUENT
TO RIVER
LAYOUT OF SEWAGE TREATMENT WORKS SHOWING LOCATION AND USE OF METERS

Layout of an Activated Sludge Plant Showing Location and Functions of Meters

Aeration Tank Control

In the aeration tanks, a properly-proportioned mixture of settled sewage and return sludge from the final settling tanks is agitated and maintained in an aerobic condition by the introduction of compressed air. By flocculation and bacterial action, in the presence of dissolved oxygen, most of the suspended and colloidal matter originally in the settled sewage is absorbed by, or becomes, floc. This floc is removed in the subsequent step of the process by sedimentation.

The settled sewage, return sludge and air can be metered independently just prior to entering each aeration tank. The sewage and return sludge then mixes upon entering the tank. The air is distributed lengthwise of the tank through porous diffusers arranged along one wall so as to produce a spiral flow of the mixture. When all three meters are arranged at the inlet end of each tank, they can be grouped within the gallery which is usually provided, for the various pipes and feeding channels, along the full width of a battery of aeration tanks. Instead of this arrangement in some large works, the sewage and return sludge is mixed before distribution to an entire battery of aeration tanks. The distributing channels, in this case, must be aerated to keep the sludge particles in suspension.

With an arrangement of independent meters, each meter can be equipped with a regulating valve, as previously described, to permit individual control. For the return sludge, a Venturi rate-of-flow controller may be used, instead of a meter with regulating valve, for each tank. In either case, an automatic control to maintain a predetermined rate can be provided.

A five-dial ratio gauge for the three meters of an aeration tank has been developed. This gauge will indicate, or indicate and record, the rates of flow of air, sewage and return sludge using the first, third and fifth dials, respectively. The second dial will give the ratio of air to sewage, calibrated in cubic feet per gallon. The fourth dial will give the ratio of return sludge to sewage, calibrated in percentage of the sewage flow. The gauges are mounted on control tables which also contain the controls for the respective regulating valves. For many years, control tables of a different design have been used for controlling the individual filters in water purification works.

Final Settling Tank Control

Final settling tanks remove the floc from the mixture which leaves the aeration tanks. The clarified supernatant liquor passes off as the final treated effluent, to be discharged into the receiving body of water. Meters with regulating valves may be used to equalize the flow of these tanks in the same manner as described for the primary settling tanks. This may only be desirable in the case of numerous units where perhaps one unit is likely to be out of service frequently. Otherwise, the effluent from each aeration tank can flow directly to a corresponding final tank by suitably arranging either stop planks or sluice gates. If these meters are included, they can be grouped with the aeration tank meters in the same gallery, provided that the aeration tanks are of a two- or four-pass type.

For the withdrawal of activated sludge from each final tank, an automatically controlled regulating valve with meter, or a rate controller, is very desirable. There are several other devices, such as adjustable overflow pipes and air lifts, which are also used for controlling the rate of sludge withdrawal. Here again, indicating and recording instruments, controls and push button stations for various motor-driven equipment can be grouped on suitable control tables or panels.

Measurement of Air

In the blower house, each centrifugal blower is provided with a Venturi meter on the intake to measure the flow of free air. These meters are essential for the efficient operation of the blowers and should be provided with individual indicating-recording instruments.

As in the case of the total sewage flow, it is also desirable to provide means for readily ascertaining the total compressed air flow from the blower house, and for repeating this reading in terms of free air to other locations. The previous remarks relating to the master sewage meter apply equally well to a master air meter.

Measurement of Sludge

The measurement of sludge has been a problem in sewage works because of the nature of the material and the relatively small flows encountered. The Kennison nozzle meter is now being used for this service. The nozzle is of special free-flowing design, utilizing the depth produced by a shaped outlet as the rate-of-flow function. The nozzle is equipped with an indicating-recording instrument. These nozzles can be used for measuring the raw sludge and the excess activated sludge prior to digestion.

In Conclusion

The cost of providing "complete" metering does not become a major item in the overall cost of sewage works designed for complete treatment. This cost, excluding regulating valves and special control devices, will approximate 3 to 5 per cent of the total cost.

In addition to the applications of Venturi metering equipment already discussed, there are many other special uses for related devices in modern sewage works, especially for control and regulating purposes. These include automatic pump controllers, sampling devices, by-pass regulators, constant liquid level controllers and the like. Many such applications comprise combinations of proven mechanical and electric elements backed by the experience and integrity of reputable manufacturers. However, it is the designing engineer's province to originate and supply these combinations for specific problems. Following in the path of industrial advances in the art of automatic control, sanitary works, too, are being so equipped. Most of the features described herein were embodied in the designs for the Columbus and Baltimore activated sludge works, with both of which the writer has been or is now associated.

[This paper, prepared for WATER WORKS AND SEWERAGE, is based on a presentation by the author before the Sanitation Group of the Am. Soc. Mechanical Engineers as part of a symposium on "Meters and Metering."]

S. E. Killam Heads Water Division

Samuel E. Killam has been appointed Director of the Water Division of the Metropolitan District Commission of Boston, as recently announced by Eugene C. Hultman, Commission Chairman.

Mr. Killam has been with the Metropolitan Water Board, and its successors, since August 1897. Since 1908 he has been in charge of the Distribution Section and since 1936 has been Deputy Chief Engr. of the Water Division. He is a past-president of the New England Water Works Association and the Engineering Societies of New England. At present he is president of the Mass. State Engineers' Association and member of the American Water Works Ass'n.

JOHN R. BAYLIS

DEXTER BRACKETT MEDALIST

JOHN R. BAYLIS
DEXTER BRACKETT MEDALIST

JOHN ROBERT BAYLIS, Physical Chemist, Department of Public Works, Chicago, on September 13, 1938, received the highest award of the New England Water Works Association—its Dexter Brackett Medal.

The Brackett Medal went to Mr. Baylis for his contributions to the advancements of water purification practices—specifically for his work on *"Filter Bed Troubles and Their Elimination"* and his outstanding paper presented before the Association on this topic, which was printed in the March 1937 issue of the N.E.W.W.A. Journal.

The medalist, who has since 1926 been in charge of the Experimental Filtration Plant of Chicago, was cited for his many contributions in the development and advancement of water treatment practice, of which twelve of the more important developments for which he had been responsible were recounted.

Mr. Baylis, a country boy from the deep south, was born and reared in the inconspicuous town of Estabutchie, Miss. He was graduated by the A. & M. College of Mississippi in 1905 and became associated with an engineering firm, which in 1913 designed one of the first filter plants in the South—that of Jackson, Miss. It became Baylis' lot to "make the thing work" after it was completed. This he did so well that Jackson made him Superintendent of its Water Department in 1915. Some of his accomplishments there put the first spotlight on John Baylis and, in 1917, he was brought to the new Baltimore, Md., Filtration Plant as Chemist, again, to "make the thing work."

When Chicago decided to construct the largest and most complete experimental filtration plant ever built, anticipating the design of a plant of 550 m.g.d. capacity at a cost of approximately $20,000,000, Mr. Baylis was selected to assist in the design and then to direct the work of this experimental plant. Since 1926 he has thus served Chicago and, as the result of the graciousness of his superiors in allowing free release of information and data, Mr. Baylis through his papers and published articles has given to the water works profession a deal of information of worth.

In the award presentation, amongst the medalist's twelve major achievements cited were the following: (1) Development of the now widely employed lime treatment for corrosion control; (2) The Baylis Turbidimeter for refined measure of turbidity, leading to improved filtration practice; (3) Methods of evaluating activated carbons in the taste and odor removal, leading to the production of improved carbons for water purification; (4) Evaluation of filtering materials, with improved specifications resulting; (5) The adaptation of silicates in improved, if not more economical, coagulation and flocculation; (6) Continuous pH recording, and specially designed electrodes therefor; (7) Improved filter bed performance, involving procedures for measuring mud-ball accumulations, and tolerance thereof; (8) The Baylis Surface Wash System for filters, which developed from his painstaking studies of filter bed behavior and filtering materials. And it should be noted that the Baylis Surface Wash System is now being adopted in important plants here and abroad, the largest being that of Milwaukee.

Mr. Baylis was also cited as the author of the exhaustive 392 page text, *"Elimination of Taste and Odor in Water,"* published in 1935. And, it was noted that he had in 1926 received the James Laurie Prize of the American Society of Civil Engineers, and in 1932 the John M. Goodell Prize of the American Water Works Association.

And, so, this is John Baylis of Estabutchie.

"Estabutchie to Erudition"

John Baylis, Associate Editor of this magazine, richly deserved the recognition given and honor bestowed on him by the New England Water Works Association.

Hailing from the obscure town of Estabutchie, in Mississippi's boll-weevil belt, it was particularly impressive that this now world known authority has built his way from cotton-field to fame.

From the halls of Mississippi's A. & M. College he carved his way to receive N.E.W.W.A.'s coveted Dexter Brackett Medal, while standing in the very shadow of New England's great institutions of scholarship and science. Likewise, at the cradle-side of the sanitary sciences and American methods of water purification and sewage treatment, stood this man from Estabutchie to receive the award. And, such was not without its significance and impressiveness. In all it was a highly pleasing event to witness this bestowal of credit to whom credit is due; to realize that America has a habit of seeking out its builders of "the best mouse-traps," wherever or whoever they may be.

In the presentation, the Medalist was cited for having produced upwards of 100 published papers and articles—many of which represent his contributions to the pages of "Water Works and Sewerage," during his valued connection as Contributing and Associate Editor since 1928. Such monthly contributions have revealed step-by-step progress in John Baylis' work and, in fact, served as the basis for his medal winning paper and others of like value. At this writing a new series by Mr. Baylis, now appearing in this magazine, bid fair to lead to another paper of medal winning caliber.

In John Baylis' prowess and recognition we of "Water Works and Sewerage" feel a considerable amount of pride and a GREAT amount of real pleasure.—Ed.

EQUIPMENT NEWS

New Flexible Joint Pipe

The new "Usiflex" Flexible Joint Pipe, recently announced by U. S. Pipe and Foundry Co., has been designed primarily for submarine lines, such as river crossings and outfall sewers, or water intakes. With a deflection tolerance of 15 degrees, it is suitable for all installations where considerable deflection may be required, or may possibly take place at some future time.

The simplicity of the "Usiflex" ball-socket joint, with a single rubber wedge-gasket, cast-iron (split) follower ring and follower flange, is readily apparent in the illustration. Assembled, the eight corrosion resistant charcoal iron bolts are inserted and tightened alternately (in pairs 180 deg. apart) with the rapid socket wrenches pictured. With the 10 in. wrench a 75 pound pull makes a bottle tight joint,

"Usiflex" Flexible Joint Pipe

but also with full flexibility to 15 degree deflection under pressures to 300 pounds per inch. There is no possible pulling apart of this joint and the pipe may be laid from barges or pulled to position when laying a stream crossing, or when installed in bored tunnels under railroad rights-of-way, paved streets or highways.

The new "Usiflex" pipes come in 12 foot lengths and sizes 4 in. to 24 in.—all with the same 15 degree deflection tolerance. That this novel joint "can take it" is thoroughly proven in a new U. S. bulletin, wherein illustrations and data of severe testing are presented, along with sufficiently detailed specifications. For a copy of "USIFLEX Joint Pipes," write U. S. Pipe and Foundry Co., Burlington, N. J.

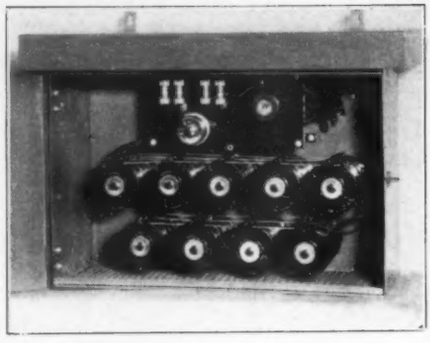
▼

Improved Rectifiers for Cathodic Protection

(Pipe, Well-Casings, Tanks)

To counteract and practically eliminate corrosion, due to galvanic action or electrolysis of under ground pipe lines, cables, etc., a copper-oxide "Rectox" rectifier, developed for cathodic protection, has just been announced by Westinghouse Electric & Mfg. Co.

These rectifiers have a rating range from 3 to 50 volts, and 1 to 125 amperes (D.C.)



The "Rectox" With Door Open

output. They consist of the necessary rectox units for the desired rating, together with a two-winding transformer, disconnect switch, and terminal board, all mounted on sheet steel ventilated cabinet designed for exposed mounting on poles or indoor use, as the case may require.

Due to the variation in resistivity of pipe coating and of soil condition, the quantity of current required varies. The "Rectox" Rectifier supplies that found necessary. Usually it has been found that if the pipe can be maintained negative to the earth by 0.3 volts or more, corrosion will be stopped.

The "Rectox" Copper-Oxide Rectifier requires no maintenance, as there is nothing to wear out, and no attention beyond the occasional check of output which is required. The "Rectox" has no rotating parts and operates entirely without noise. An extremely important characteristic is that it operates without causing radio interference.

Recently successful experiences have been reported with cathodic protection applied to water tanks and standpipes, with interior corrosion essentially stopped at reasonable expense for current required and initial installation. Cleaning and painting has been reported avoidable, as the result of such cathodic protective applications.

For a copy of "Rectox" folder (Data Folder 27-450) write "Westinghouse," East Pittsburgh, Pa.

▼

Pressure Feed Ammoniator

For small water plants % Proportioneers %, Inc., are offering the Heavy Duty Midget AMM-O-FEEDER, which provides proportional feed as does their companion unit—the Heavy Duty Midget CHLOR-O-FEEDER.

The ammonia feeder is of the displacement piston-type, for positive action against heads of 10 to 150 lbs. per inch. It is especially designed to feed aqua-ammonia, one of the most economical sources of ammonia for small users. Or it will feed ammonium sulphate solution. The output of the new Midget Ammonia Feeder varies from 0 to 5 gals./hr. and is driven by a 1/6 H.P. drip proof motor (110 volt, 60 cycle, single phase). The speed is varied by operating a four-step cone pulley to vary the dosage. The rate of feed automatically changes with flow changes.

For further details ask for AMM-O-FEEDER leaflet. Write % Proportioneers %. Inc., 9 Codding Street, Providence, R. I.

▼

New Paint for Creosoted Surfaces

A new paint, said to be the first really successful coating for creosote treated wood-block floors (poles and timbers also) has been developed by Reilly Tar and Chemical Corp. of Indianapolis, established manufacturers of protective coal-tar coatings and paints.

The new material, known as Reilly Creo-Coat Paint, has been in process of development and test over a period of years. It dries with a bright hard finish; is resistant to abrasion; impervious to oils and dilute acids. Neither pitch nor creosote penetrate it. It comes in five colors—green, yellow, red, brown, black—for providing a pleasing surface over decay resisting creosote applications.

For details, write Reilly Tar & Chemical Corp., Indianapolis, Ind.

▼

A Sewer Pipe Locator

The Blake Sewer Pipe Locator, an invention of a practical sewerage official, is being offered by the Nopee Trading Co. of Newton Center, Mass.

The equipment, in a neat and compact carrying case, consists of a reel of steel tape, a transmitter and a rectangular receiving coil (12 x 12 inches), to which is attached a pair of ear phones. In appearance the equipment is similar to water pipe location apparatus but of an entirely new design, involving about 1 mile of very fine copper wire.

The transmitter is a bullet-nosed cylinder 8 in. long by 3 in. in diameter. It contains dry cells, a vibratory circuit breaker, transmitting coil and condenser. To one end of the bullet transmitter is attached the 100 ft. spring-steel tape. Down in a manhole a man feeds out the tape which pushes the transmitter ahead, aided by the flow of sewage. On the ground, above, the other member of the two-man team follows the course of the transmitter, by use of the receiver coil, just as one would follow the course of a water main but with less difficulty perhaps.

With the aid of ear-muffs, to filter out street noise, the buzzing signals are kept clearer, allowing sewer location through as much as 20 ft. of earth. No skill is required to operate this novel locator and the manufacturer boasts no single case of failure of the instrument to locate sewers quickly and accurately.

For a folder illustrating and describing the novel Blake Sewer Locator, write Nopee Trading Co., Box 93, Newton Center, Mass.

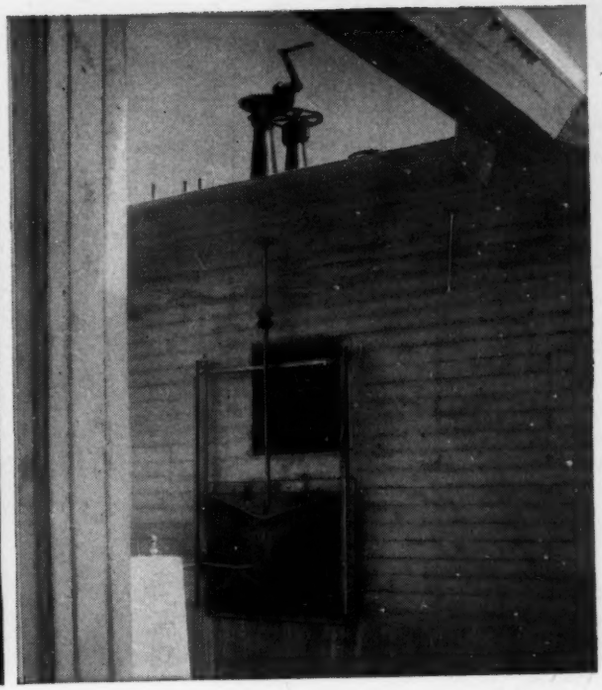
▼

A Non-Slip Wax by Flexrock

A non-slip wax, to minimize accidents on smooth floors, tile, terrazzo, linoleum, etc., has been perfected by the Flexrock Company of Philadelphia. This safety wax is made from pure carnauba treated by a special process to develop the non-slip feature. It is applied with a cloth or mop; requires neither rubbing nor polish-

EVERDUR ... Strong, Corrosion-resisting,

installed in San Francisco's Richmond-Sunset Plant



Photographs show three of the nine gates recently installed in the Richmond-Sunset Sewage Treatment Plant of the City and County of San Francisco, Calif. Dimensions vary, one is 36″ x 48″, four are 36″ x 36″ and four others 24″ x 24″. The gate bodies are Everdur castings, the lifting stems were made of 1½″ Everdur rod, the guides from brake-formed Everdur angles. All reinforcement cross bars, as well as all nuts, bolts, washers, etc., are Everdur. Equipment fabricated and installed by the California Corrugated Culvert Co.

FOR more than ten years, Everdur has been employed with outstanding success in the sewage treatment, reservoir and water works fields. Throughout this service it has shown uniformly excellent resistance to corrosion under a wide variety of severe operating conditions.

This Anaconda Copper-Silicon Alloy is economical to use, for it is readily workable either hot or cold, and can be welded by any of the commonly used methods. The steel-like strength of Everdur Metal, and its availability in all commercial shapes, make possible many fabricating economies—and the use of light weight wrought shapes for built-up structures. Experienced Service Engineers of The American Brass Company are available at all times for consultation on the selection and fabrication of metals for sewage and water works service. Anaconda Publication E-11 gives detailed information about Everdur Metal in this field. Write for a copy. 39234

Everdur Metal

ANACONDA

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont. • *Subsidiary of Anaconda Copper Mining Company*

"EVERDUR" is a trade-mark of The American Brass Company, registered in the United States Patent Office.

COPPERAS
(FERROUS SULPHATE)
··· FOR WATER & SEWAGE TREATMENT
(The Base For Chlorinated Copperas)

SEWERAGE TREATMENT

For Sewerage Treatment, we wish to call your attention to a well-known authority* and his published reasons* for selecting Chlorinated-Copperas, as a coagulant.

1—Chlorinated-Copperas proved to be the cheapest coagulant to produce desired results under existing conditions.

2—Chlorinated-Copperas is desirable as a coagulant because of ease of handling, low cost, and ease of application.

(*Name available upon request.)

WE INVITE YOUR INQUIRIES

FAESY & BESTHOFF, INC.
22 E. 40th St. New York

ing. It dries rapidly (20 min.) with a leather-like texture of rubbed wax gloss; can be applied as touch-up to worn spots without visible overlap. If interested in a trial can, write Flexrock Company, 800 N. Delaware Ave., Philadelphia.

▼

Novel Acid-Proof Brick

The Sauereisen Cements Company, Sharpsburg, Pa., have developed an acid proof brick of novel design, known as the Sauereisen Pour-Lay Brick. The brick is particularly adapted to use in all types of acid proof construction such as acid or ferric chloride tanks, sewers, stacks, etc. The unique design includes pouring cavities, so arranged as to allow the brick to be laid dry and in such a manner as to present a smooth and solid surface without joints. A molten sulphur of asphaltic joint compound is used for sealing, no spacers or joint seals being required. Manufacturing rights will be licensed to brick producers.

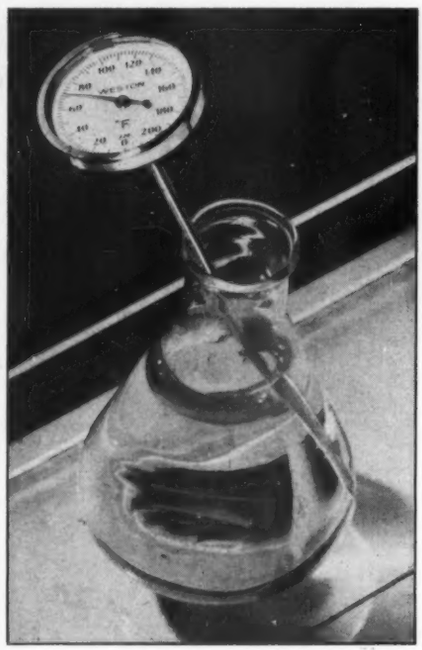
For further details request literature from Sauereisen Cements Co., Sharpsburg, Penna.

▼

Stainless Steel Thermometer

An entirely new type of laboratory thermometer, provided with a dial-and-pointer scale encased in stainless steel, mounted on top of an 8-inch stainless steel stem, is being introduced by the Weston Electrical Instrument Corporation, Newark, N. J.

The unit is said to be the first dial-type thermometer with an all-metal temperature element sufficiently accurate for scientific use. The pointer is actuated by means of an internally balanced double coil of thermostatic bimetal sealed in the lower 1½ inches of the seamless stem. When the stem is immersed to a depth of 1½ inches (or more) in a liquid, the dial reads temperature values accurately without the necessity for stem correction. Accuracy of



Laboratory Thermometer

the unit is guaranteed to ½ of 1% over the entire scale.

Initial models of the unit are being offered in the following scale ranges: 0-220 deg. F., 50-300 deg. F., 50-500 deg. F., 0-100 deg. C., 0-150 deg. C.

For descriptive literature, write Weston Electrical Instrument Corporation, Newark, N. J.

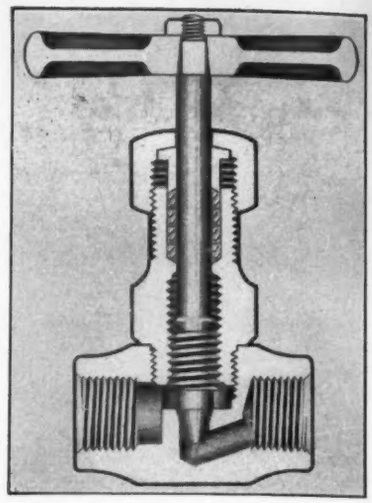
▼

Crane's New Bar Stock Valves

Three new bar stock valves which have a variety of uses have been introduced by Crane Co., Chicago. These small plug-type disc valves (globe and angle) are called bar stock valves because their bodies and bonnets are made from solid bar stock. They are considered ideal for connections on orifice meters, regulator leads, by-passes, gauges; and for use where accurate regulation of flow is desired or where parts of measuring instruments must be protected against the sudden release of high pressures.

The construction of these valves allows repacking when wide open and under pressure. They are furnished either in steel, Excelloy or 18-8 chrome nickel alloy. The alloy valves are particularly suitable for handling gas or liquid containing sulphur compounds or for installations where steel valves do not have sufficient resistance to atmospheric corrosion.

This new Crane valve is also made with one male and one female end in sizes ⅛ to ¾ inch inclusive. This pattern is consid-



Crane New Bar Stock Valve

ered especially convenient where it is desirable to screw the valve directly into equipment having a female opening, thus eliminating the need for a nipple. Crane bar stock valves, therefore, now include the globe and angle patterns with female ends in sizes ⅛ to 1 inch inclusive, and the new globe pattern with one male and one female end.

For descriptive leaflet write, Crane Co., Chicago.

▼

Non-Clogging Centrifugal Pumps

The Gardner-Denver Company, Quincy, Illinois, announces their Types "J" and "K" Non-Clogging Centrifugal Pumps, for both horizontal and vertical dry pit installations.

The impeller is made of hard close grained alloyed cast-iron having two streamlined blades, which are rounded to prevent catching stringy or fibrous material. It is of the side suction enclosed type and is carefully balanced, it is keyed to the shaft and securely held in place with an impeller screw which conforms to the impeller contours and which is locked in place with a brass set screw.

The casing of the new pumps is made of high tensile strength alloyed cast iron, of more than usual thickness. It is symmetrical so that it can be used for both right and left hand pumps, and the dis-

Gardner-Denver Non-Clogging Centrifugal Pump

charge nozzle can be placed in any of eight positions.

The stuffing box is a separate casting bolted directly to the casing and is extra deep to receive a minimum of six rings of packing. A water seal ring is provided with tapped opening for connection to clear water or effluent. Heavy duty double row grease lubricated ball bearings, contained in dust and splash proof housings, are used. These bearings are the bearing manufacturers', "selected fits" to insure quiet operation and long life. Disc or flat type renewable double wearing rings are provided on the impeller and front head. This type of wearing ring does not hold abrasive materials between the wearing surfaces, but throws them out by centrifugal force.

The clean out elbow is provided with a plug having the same contour as the elbow to form a smooth continuous flow. A pipe tapped opening in the side of the elbow can be used for the installation of a sump drain when desired. The mechanical construction of the "J" and "K" pumps is identical except that the frame of the Type "J" pump has a foot cast integral with it and the Type "K" pump has the foot or base bolted on the suction side of the volute.

A new bulletin more minutely describes these new pumps. For a copy write Gardner-Denver Co., Quincy, Ill.

WITH THE MANUFACTURERS

Dorr Co. Markets Magnetite Filters

The Dorr Company, Inc., has acquired from Filtration Equipment Corporation, of New York, exclusive sales rights (United States) to the Automatic Magnetite Filter. Such filters, although marketed and serviced from now on by The Dorr Co. will be designed and manufactured by Filtration Equipment Co., as in the past.

The Automatic Magnetite Filter improves the quality and uniformity of effluents from sedimentation tanks by straining out essentially all of the suspended solids left in the sewage after the sedimentation period. In addition to such effluent "polishing," a reduction in B.O.D. is accomplished in direct relation to the solids caught by the filter. This filter is especially adaptable in the treatment of trade wastes, and also has a place in water purification—especially in softening and filtration of industrial water supplies. Its chief feature is trouble free and economical operation.

As to economy of installation, the filter bed of crushed and graded magnetite iron ore may be installed in the sedimentation tank itself, concentric with the parallel to the overflow launder; or, it may be placed in a separate structure. It is ideally adapted to installation around the periphery of round Dorr Clarifiers, since the motor that drives the clarifier mechanism may also be used to drive the traveling cleaner of the filter.

For details and descriptive literature—write The Dorr Co., 570 Lexington Ave., New York City.

G. T. Luippold Organizes Sales Company

G. T. Luippold, for 13 years in charge of the Los Angeles office of Wallace & Tiernan Co., has organized the Luippold Engineering Sales Co., with offices at 115 South Hope St., Los Angeles. Mr. Luippold's organization serves as manufacturers' representative and sales agent.

At present the company has been appointed agent for Wallace & Tiernan Co.; Water Leak Detector Co., of Columbus, Ohio (radio leak detectors and pipe locators); Charcoal and Industrial Carbons, Inc. (activated carbons); Flexible Sewer Rod Co. (sewer and watermain cleaning equipment). For the following firms they are sub-agents: Pacific Fish Tank Co. (general line of sewage treatment equipment); Simplex Valve and Meter Co. (meters, rate controllers, gages, and sewage equipment); E. W. Bachrach & Co. (filter plant and softening equipment); Eddy Valve Co. (valves and fire-hydrants).

Now serving as Chairman of the Purification Div. of the California Section of A.W.W.A., "Lui" has a host of friends. His valuable W&T. sales engineering experience, plus his good friends, are standing his new company in good stead. We understand that he is contemplating expanding, in order ot more effectively cover the West Coast with a gradually growing line of equipment and materials.

Meter Service Offered by New Company

The National Conservation Company of New York City has been established for the purpose of giving a general meter and metering service to municipalities and water companies.

V. Bernard Seims and D. F. Noonan, well known in the water works field, have organized the new company which offers meter repair, maintenance, and testing service, on all types of liquid meters. In addition the company proposes to take on complete supervision of meter systems of municipal and private water works with anticipated savings to the client.

Offices of National Conservation Corp. have been established at 80 Broad Street, New York City. The service station and repair shop is located in nearby Ridgewood, Long Island, N. Y.

Research Products Corp. Formed by Burgess Labs. Staff

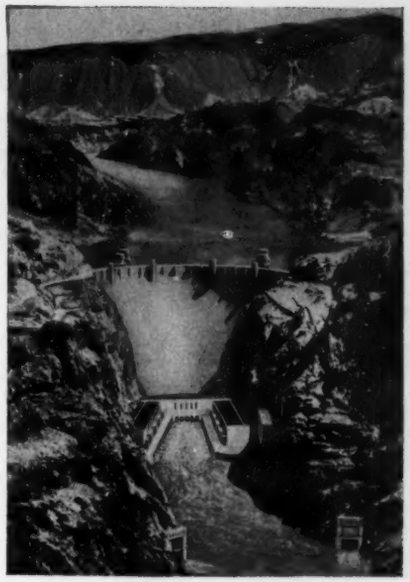
The Research Products Corporation, Madison, Wis., has taken over the Water Treatment Division of the C. F. Burgess Laboratories, Inc.

The new company will continue with the same personnel, plant and equipment, and will manufacture softening Zeolites, "Birm" for removing iron, hydrogen exchange "Alkalex" for removing alkalinity from waters, and a variety of filtering materials.

The officers of the new corporation are: Howard F. Weiss, President; Kemper Slidell, Vice-Pres.; Milton J. Shoemaker, Sec'y; and Max H. Klieforth, Treasurer.

Besselievre in South Africa Ford Back Home

E. B. Besselievre, now resident Dorr Engineer in the Argentine, has been sent to Capetown, South Africa, on a special assignment on sanitary engineering projects.



Bailey Meters AT BOULDER DAM

● In Boulder Dam Power Plant as in many other new hydro-electric stations including Madden Dam and Norris Dam, Bailey Fluid Meters are installed on hydraulic turbines.

At Boulder Canyon, the Bailey Meters measure water supply through 13 foot diameter penstocks under an average head of 530 feet. These meters indicate and record the water flow in terms of cubic feet per second and continuously integrate in millions of cubic feet. The registers are operated by pressure connections in the turbine scroll casings.

While your project probably does not entail the volume and head of water that is being measured at Boulder Canyon, it is nevertheless, important that your measurements of flow and liquid level be accurately made by reliable equipment.

Write for complete information on the application of Bailey Meters to your problem. MU-19

BAILEY METER • COMPANY •

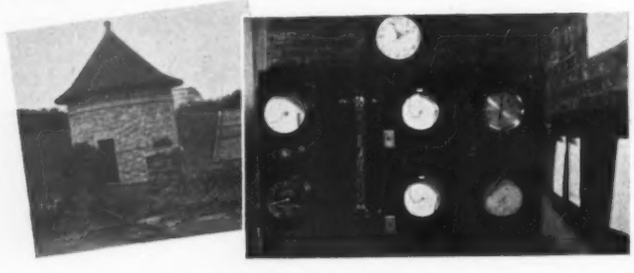
1072 Ivanhoe Road, Cleveland, Ohio

BAILEY METER COMPANY LTD., MONTREAL

FLOW AND LEVEL METERS FOR THE COMMUNITY PLANT

WESTCHESTER, N. Y.
Panel mounted Type M. Venturi Register—Indicator—Recorder at Rye Lake Pumping Station.

RIDGEWOOD, N. J.
Chronoflo Meter measures flow of raw sewage over weir and controls Wallace & Tiernan dry chemical feeder in proportion to flow; "saving about 200 lbs. of alum per day."



NEW ROCHELLE, N. Y.
Chronoflo Transmitters in the Metz Reservoir Gate House transmit water level to distant Chronoflo Recorders. Venturi Meter measures flow.

Experienced engineers and superintendents of small, large, and medium size plants choose Builders Venturi and Chronoflo Meters and Controllers to aid in maintaining initial efficiency and in keeping down cost of operation.

Bulletin 298 shows many new applications of Chronoflo Meters. Would you like it?

BUILDERS IRON FOUNDRY
"Builders of the Venturi Since 1891"
9 Codding St. Providence. R. I.

MEETINGS SCHEDULED:

Oct. 17-20—Oklahoma City, Okla. (Hotel Biltmore).
Southwest Section, A. W. W. A. Sec'y, L. A. Quigley, Supt. City Water Works, Fort Worth, Texas.

Oct. 19-21—Atlantic City, N. J. (Hotel Haddon Hall).
Pennsylvania Water Works Assn. Sec'y, Dr. F. Herbert Snow, 327 Telegraph Bldg., Harrisburg, Pa.

Oct. 21-22—Asbury Park, N. J. (Berkeley-Carteret Hotel).
New Jersey Section, A. W. W. A. Sec'y-Treas., H. N. Lendall, College of Eng., Rutgers University, New Brunswick, N. J.

Oct. 20-21—Toronto, Ont.
Canadian Institute of Sewage and Sanitation. Sec'y-Treas., A. E. Berry, Ontario Dept. of Health, Toronto.

Oct. 25-28—Kansas City, Mo.
American Public Health Association. Executive Secretary, Reginald M. Atwater, M. D., 50 West 50th street, New York City.
Conference of State Sanitary Engineers. Sec'y-Treas., R. E. Tarbett, U. S. P. H. Service, Washington, D. C. (Meeting jointly with A. P. H. A.)

Oct. 26-29—Riverside, Calif. (Mission Inn).
California Section, A. W. W. A. Sec'y, Carl M. Hoskinson, Div. of Water, Sacramento, Calif.

Oct. 31-Nov. 2—Greensboro, N. C. (King Cotton Hotel).
North Carolina Section, A. W. W. A. Sec'y-Treas., A. R. Hollett, Chapel Hill, N. C. Meeting jointly with North Carolina Sewage Works Association.

Nov. 16-19—Atlanta, Ga. (Georgia Tech.).
Georgia Water and Sewage Operators' Ass'n and Short School. Sec'y-Treas. Paul Weir, Supt. Filtration, Atlanta, Ga.

Jan. 18-20, 1939—New York City (Eng. Soc. Bldg.).
American Society Civil Engineers. Sec'y, Geo. T. Seabury, 33 West 39th St., New York City.
(Jan. 19—Sessions and Joint Annual Dinner of the Sanitary Engineering Division.)

Jan. 19-21—New York City (Hotel McAlpin).
New York State Sewage Works Ass'n. Sec'y, A. S. Bedell, State Board of Health, Albany, N. Y.
(Jan. 19—Joint Annual Dinner with Sanitary Engineering Division.)
(Jan. 21—Joint inspection trip with San. Eng. Div. of A. S. C. E.)

CATALOGS AND LITERATURE RECEIVED

[*Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.*]

"Westco Utility Turbine Pumps" are described in a bulletin from Micro-Westco Inc., of Bettendorf, Iowa. These interesting compact pumps involve a combination of displacement-turbine and centrifugal design, which allows variable volume output and pressure control without material change in pumping efficiency. The multi-vaned bronze impeller, the only moving part, is held in perfect balance by split suction, and operates without metal to metal contact. The single multi-vane impeller produces a multi-stage centrifugal effect, to produce pressures exceeding conventional single stage centrifugals. A distinctive feature is the removable impeller and two liners, which may also be had in various alloys for pumping highly corrosive or abrasive liquids. Thereby, the casing never deteriorates with service and only three parts need be stocked for quick replacement, providing essentially duplicate equipment. These utility pumps, which come in stationary and portable models,

are finding a variety of applications in water and sewage plants—especially in connection with handling chemical solution or pressure boosting for injector operation, valve operation, jetting, and other service, requiring pressure boosting. The distinctive features of these pumps can only be effectively understood by the picturized description and capacity-performance tables in the bulletin of "100 Pumps Within a Pump." For Form 714 write Westco, Inc., Bettendorf, Iowa.

"Soft Water for Your Community" presents an excellent pictorial review of the benefits of SOFT water. "After ransacking the entire country we are selecting this remarkable booklet from scores of worthy exhibits. You will wish to read it again and again. . . . After April 1, 1939, pure SOFT water will henceforth flow to the factories, industries and homes of the metropolitan district." So states a letter from Scotland G. Highland, General Manager of the Water Board of Clarksburg, W. V., addressed to water takers in the Clarksburg area. While Clarksburg is now assured "SOFT water" from a plant already under construction, and while Manager Highland is still selling his community on SOFT water, we wish to direct the attention of our readers to the availability of the brochure which Mr. Highland finds so praise-worthy.

"Soft Water for Your Community" will make a splendid sales appeal in any hard water community. So if you wish SOFT water appeal, "packaged" in popular reading style, tell us the number of copies needed. We will assist you in securing your requirements at no cost. We have available a supply for mailing single copies of this worthy brochure as long as they last.

"Triple-A Protective Coatings," including a worthy paint which can be successfully applied to wet surfaces or sweating pipes, are presented in a bulletin from Quigley Co. of New York. Qualities stressed are (1) high power of pore and rust penetration; (2) Non-porous, drying by rapid evaporation rather than slow oxidation; (3) Chemical neutrality and resistance to sulfur fumes, acids or alkalies; (4) Elasticity and tenacity at all temperatures. Triple A No. 44 is a black base paint containing aluminum powder. One coat provides under protection enhanced by the attractive appearance of the aluminum. Triple A No. 20 is the heavy-duty black for general use on steel work, pipe lines, etc. To this reviewer one of the most remarkable of Quigleys paints is Triple A No. 10 for general use on metal, wood, concrete et al. Its distinctive quality is that it can be applied to *wet* surfaces, sweating pipe, etc., and it *sticks*. This is the paint which came in for much praise in Virginia Section's Superintendents' Round Table reported elsewhere in this issue. For a copy of Quigley's "Prevent Corrosion" bulletin, write Quigley Company, 56 West 45th Street, New York, N. Y.

"Hydraulic Rams, by Rife." Of never ceasing interest is the hydraulic ram for lifting water "by its own boot-straps," so to speak. "How and Why a Ram Pumps Water," by putting water hammer to good use, is revealed in a new booklet from the long established Rife Hydraulic Mfg. Co., widely known for their Double Acting Rams. The latter put water head from a non-potable source to work lifting water from a potable source, with a minimum of waste of pure water. The booklet discusses basic requirements and operating features of various ram installations, pictures typical applications and alternate designs of drive pipes, locations, etc. If you wish a copy of "Hydraulic Ram Informa-

WORKS ALL WINTER

Ferrisul doesn't lie down on the job as soon as winter comes. Its heavy floc forms and settles quickly at low temperatures. Acid conditions, caused by the building up of CO_2 in ice bound reservoirs, actually improve its efficiency. For Ferrisul works best on the acid side in the neighborhood of pH 4.5 to 5. . . . Ferrisul is easy to handle, easy to store, and requires a minimum of control in operation. Equipment for feeding Ferrisul may be used equally well for other coagulants. Ask your consulting engineers about its use, or write direct to us. Monsanto Chemical Co., Merrimac Division, Everett Station, Boston, Mass.

Ferrisul

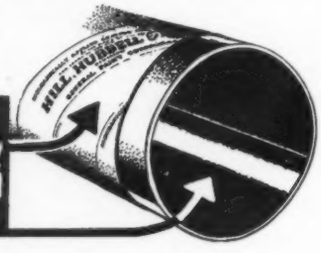
(anhydrous ferric sulfate)

FOR WATER AND SEWAGE TREATMENT

always REMEMBER the RECORDS show FEWER BREAKS WITH STEEL PIPE

There are MANY advantages of STEEL PIPE over other kind of pipe, but one of the most outstanding is that YOU HAVE FEWER BREAKS. This is a matter of RECORD and not an idle claim. Experience has proven that STEEL PIPE withstands vibration, water hammer, high pressure, bending and deflection better than other kind of pipe. The HILL-HUBBELL Process of Lining with BITURINE AKWALINE Enamel and Coating-and-Wrapping with BITURINE Enamel is what assures LONG USEFUL LIFE and CAPACITY FLOW. With our Process all work is done MECHANICALLY—at the Mills—INDOORS. This eliminates the risk of human error and poor workmanship and the danger of defects due to all weather hazards.

STEEL PIPE Lined INSIDE and Coated-and-Wrapped OUTSIDE



59/16" O.D. STEEL PIPE
WASHINGTON, INDIANA

You should have a copy of "Pipe Protection." It describes in detail the HILL-HUBBELL Process and contains prices. A request sent to our nearest office on your letterhead will bring you a copy.

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
TULSA • SAN FRANCISCO • LOS ANGELES • OAKLAND • PORTLAND • SEATTLE • SPOKANE

tion" write Rife Hydraulic Ram Mfg. Co., 75 West St., New York City.

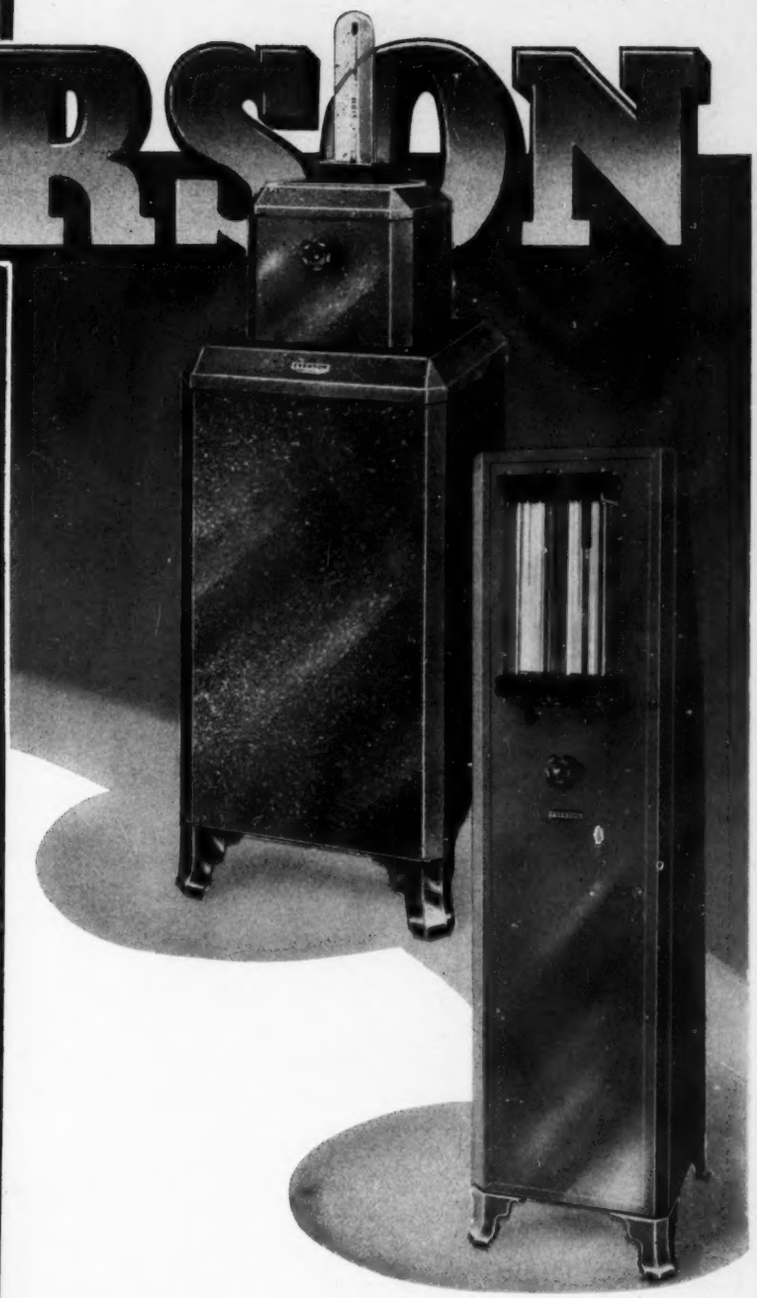
"Protecting Sewerage Structures and Equipment"—How and what to use, and where and when to use WHAT, constitutes a staccato definition of the context of a worthy guide to protection of sewerage structures and equipment, just released. Wailes, Dove-Hermiston Corporation, with 70 years of experience in production of protective coatings and pioneering in applications of bituminous materials—"Bitumastic" and kindred products—offers a ready reference guide of recommended coatings for the type of structure and class of equipment in present day sewage works. Condensed flow sheet guides cover 6 representative processes of sewage treatment and types of plants. Below each appears an alphabetical listing of those structures and equipment involved, with the recommended protective coating opposite each. Thus the engineer or plant manager is guided in specifying or choosing the correct coating, the properties of each being detailed on the last page. This rapid use guide thus covers, in four pages, what might have otherwise taken a book to present. For a copy write Wailes, Dove-Hermiston Corp., 17 Battery Place, New York, N. Y.

"Universal Leak Detectors"—Improved models and the complete line of the "Universal" radio type pipe locating and water leak detection equipment, which converts the hiss of a leak into the roar of Niagara dimensions in leak tracing, are presented in a bulletin by Water Leak Detector Co. of Columbus, Ohio. There are 1938 "Super Power" models, Junior models or "Midgets" for limited leakage surveys and on pipe location work. The new bulletin also offers to arrange for a leak survey, on a contract basis, for those cities which are not now in a position to purchase equipment or have not the required personnel. Some outstanding experiences of those using the "Universal" are set forth as reproduced letters. For a copy of the new "Universal" bulletin, write Water Leak Detector Co., 155 North 3rd St., Columbus, Ohio.

"Acme Full Vision Masks"—Are described in a new bulletin from Acme Protection Equipment Company of Pittsburgh. In our January issue was described the new full vision Acme gas mask, which has been designed for the maximum comfort of the wearer, and which features the large non-fogging and shatter-proof full-vision "windows" instead of eye-pieces. Now the Acme Mask is available as a fresh air hose mask, as well as cannister mask. Both have been approved by the U. S. Bureau of Mines. For a copy of "Acme Full Vision Masks and Respirators," write Acme Protection Equipment Company, 3616 Liberty Ave., Pittsburgh, Pa.

"Johnson Well Screens" are described and pictured in a new catalog from Edward E. Johnson, Inc., of St. Paul, Minn., which presents the distinctive features of welded Johnson well screens of red-brass and other corrosion resistant alloys, one feature being the continuous non-clogging slots, productive of streamline inflow. Interesting pictures reveal the punishment that Johnson screens can take. Chapters are devoted to "Methods of Installation"; "Methods of Withdrawal"; "Developing Sand and Gravel Wells With Surge Plungers or Compressed Air"; *"Stabilized* Gravel Pack Wells vs. Ordinary Gravel Wall Wells." Johnson's "Red Head" Drive Well Points, of design like the proven well screen, are also presented. Design and computation data for use of engineers and well drillers add value to the production. For Catalog 538 write, Edward E. Johnson, Inc., St. Paul, Minnesota.

EVERSON



EVERSON Sterilizing Apparatus measures, mixes and feeds chlorine and other gasses in solution in proper capacities and types for waterworks and sewage use.

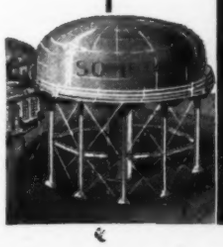
Gas flow is controlled with extreme accuracy by means of a single valve control; is measured in micro calibrations by a visible eye level Rota-Meter.

EVERSON Sterilizers are made automatically safe—gas flow is synchronized with "on" and "off" of water pump, is also protected by automatic shut-off in case of pressure failure by an automatic vent syphon break that prevents back-flooding.

All operation is under vacuum, is water sealed, all parts easily accessible and parts contacting chlorine or chlorine solution are rubber, glass, silver or tantalum.

Having large capacity range to meet any requirement, this new, modern equipment comes with a choice in attractive cabinets.

■ *Write for Special Bulletins and Prices*



EVERSON MANUFACTURING CO.

214 WEST HURON STREET, CHICAGO, U. S. A.

New York City, N.Y. Detroit, Mich. Dallas, Texas Nashville, Tenn. Amarilla, Texas Moline, Illinois
Boston, Mass. Pittsburgh, Pa. Houston, Texas Miami, Florida Wichita, Kansas Missoula, Mont.
St. Louis, Mo. St. Paul, Minn. Oklahoma City, Okla. Dayton, Ohio San Antonio, Texas Worthington, Ind.

BIRDS OF A FEATHER

FLOCCULATE TOGETHER

...MORE QUICKLY, with P.Q. Silicate of Soda. Now you can bring suspended matter from river or lake into a flocculent condition and clear your water supply in less time.

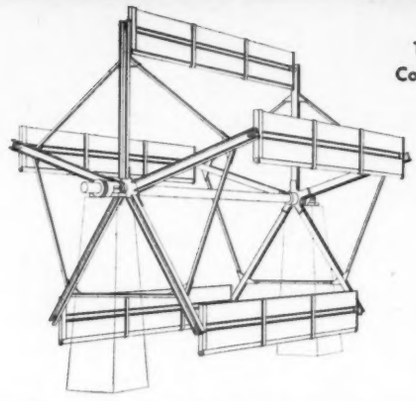
As much as half the time can be saved by using, with your alum, the proper dosage of P.Q. Silicate.

Get increased filter capacity this summer. Jar tests will prove the value of P.Q. Silicate in your plant. Write for more details.

PHILADELPHIA QUARTZ COMPANY
General Offices and Laboratory: 125 S. Third St., Phila., Pa.
Chicago Sales Office: 205 W. Wacker Drive. Stocks in 60 cities.
Sold in Canada by NATIONAL SILICATES LTD., Toronto, Ont.

PQ SILICATE OF SODA

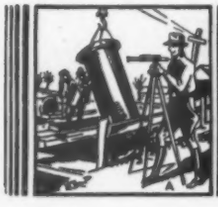
INFILCO Controlled Coagulation



Type F Coagulator

- INFILCO Type F Coagulators provide unusual operating flexibility to meet changes in coagulating conditions. Paddle speeds can be changed at will. Multiple coagulator reels may be equipped with separate drives.
- **The many other Type F advantages are described in Bulletin 710. Write for it.**

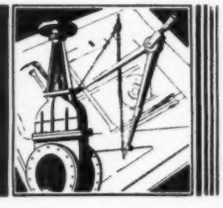
INTERNATIONAL FILTER CO. 59 E. Van Buren St. Chicago, Ill.



Consulting Engineers

Specializing in the field of

WATER WORKS & SEWERAGE



Albright & Friel, Inc.
Engineers
Chester E. Albright — Francis S. Friel
Water Supply and Purification
Sewerage and Sewage Disposal
Industrial Waste and Refuse Disposal
Investigations — Valuations — Reports
1520 Locust Street
Philadelphia, Penna.

Burns & McDonnell
Engineering Co.
McDONNELL-SMITH-BALDWIN-TIMANUS-McDONNELL
Consulting Engineers Since 1897
Waterworks, Light and Power, Sewerage, Reports, Designs, Appraisals, Rate Investigations
Kansas City, Mo., 107 West Linwood Blvd.
Cincinnati, Ohio, 307 East Fourth St.
Albany, N. Y., 11 North Pearl St.

Gascoigne & Associates
Consulting Sanitary Engineers
G. B. Gascoigne — A. A Burger
W. L. Havens — F. W. Jones
C. A. Emerson, Jr. — F C. Tolles
Water, Sewage, Garbage and Industrial Waste Problems — Valuations and Rate Investigations
CLEVELAND, Leader Bldg. — NEW YORK, Woolworth Bldg.

John W. Alvord
Charles B. Burdick
Louis R. Howson
Donald H. Maxwell
Alvord, Burdick & Howson
Engineers
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation
Civic Opera Building — Chicago

Campbell, Davis & Bankson
The Chester Engineers
Water Supply and Purification, Sewerage and Sewage Treatment, Power Development and Applications
Investigations, Appraisals, Rates, Testimony, Design, Supervision, Operation, Accounting
130 Seventh Street, Pittsburgh, Pa.

Greeley & Hansen
Hydraulic and Sanitary Engineers
Investigations and Reports. Plans and Specifications. Supervision of Construction. Supervision of Operation. Water Supply and Purification, Sewerage and Sewage Disposal, Garbage Collection and Disposal, Appraisals
6 N. Michigan Avenue, Chicago, Ill.

Black & Veatch
CONSULTING ENGINEERS
4706 Broadway, Kansas City, Mo.
Sewerage, Sewage Disposal, Water Supply, Water Purification, Electric Lighting, Power Plants, Valuations, Special Investigations, Reports and Laboratory Service
E. B. Black — N. T. Veatch, Jr.
A. P. Learned — H. F. Lutz
F. M. Veatch — E. H. Dunmire
E. L. Filby

Fuller & McClintock
Engineers
Sewage Treatment, Sewers, Waterworks, Purification, Drainage, Waste Disposal, Valuations
11 PARK PLACE — NEW YORK

Nicholas S. Hill Associates
Consulting Engineers
Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction, Operation, Management, Chemical and Biological Laboratories.
112 East 19th St.
New York

Morris Knowles, Inc.
Engineers
Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning.
Pittsburgh, Pa.

METCALF & EDDY
Engineers
Water, Sewage, Drainage, Garbage and Industrial Wastes Problems
Laboratories Valuations
Boston, Mass. Statler Building
Harrisburg, Pa. Telegraph Building

Reeves Newsom
Engineer-Consultant
WATER WORKS—SEWERAGE
Construction and Operation
Investigation and Design
Valuation and Rates
500 FIFTH AVE. NEW YORK

Nussbaumer & Clarke, Inc.
Newell L. Nussbaumer Irving Clarke
Water Supply & Purification
Sewerage & Sewage Disposal
Garbage Incineration
327 Franklin St. Buffalo, N. Y.

Malcolm Pirnie
Engineers
Water Supply, Treatment, Sewerage Reports, Plans, Estimates.
Supervision and Operation. Valuation and Rates.
25 W. 43rd St., New York, N. Y.

Potter, Alexander, C. E.
Hydraulic Engineer and Sanitary Expert
Sewerage and Sewage Disposal, Water Supply and Purification.
50 Church St., New York

Sheppard T. Powell
Chemical Engineer
Treatment of Water for Industrial Uses. Trade Waste Investigation and Correction. Technical Expert in Litigations.
330 N. Charles St.
Baltimore, Maryland

Thomas M. Riddick
Consulting Engineer and Chemist
Municipal and Industrial Water Purification, Sewage Treatment, Operating Supervision of Plants, Sanitary Surveys, Stream Pollution Investigation, Swimming Pool Control. Chemical and Bacteriological Analyses, Testing of Materials.
369 East 149th Street, New York City (Tel.: Melrose 5-6579)

Russell & Axon
Consulting Engineers, Inc.
Geo. S. Russell—John C. Pritchard
Joe Williamson, Jr.
Sewerage, Sewage Disposal, Water Works, Filtration, Softening, Power Plants
4903 Delmar Blvd. St. Louis, Mo.

Weston & Sampson
Robert Spurr Weston George A. Sampson
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service, Supervision, Valuations.
14 Beacon Street Boston, Massachusetts

Whitman & Howard
Harry W. Clark, Associate
Engineers (Est. 1869—Inc. 1924)
Channing Howard Paul F. Howard
Walter A. Janvrin C. Roger Pearson
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

Whitman, Requardt and Smith
Engineers
Ezra B. Whitman Norman D. Kenney
Gustav J. Requardt Robert T. Regester
Benjamin L. Smith Theodore W. Hacker
Water Works — Sewerage Utilities
Baltimore, Md. Albany, N. Y.

CAN WE HELP YOU?

Do you want latest literature and catalogs?
Do you want additional help or information on contemplated purchases?
WATER WORKS & SEWERAGE readers are invited to take full advantage of our "Readers Service Department" which will assist you, without cost or obligation, in obtaining catalogs, literature, etc., or any other information you desire.
Use convenient blank below.

READERS SERVICE DEPT.,
WATER WORKS & SEWERAGE,
155 East 44th Street, New York, N. Y.
Please send me without obligation, literature or information on following:

.....

.....

.....

NAME .....

POSITION .....

ADDRESS .....

DATE .....
Oct.

DO YOU SUPPLY WATER TO NEIGHBORING TOWNS?

Is there a wide range of flow in your distribution system? Are there periods when dollars slip away in the streams too small to be measured by the meters provided for high flows?

THEN YOU NEED A SPARLING COMPOUND MAIN-LINE METER!

Accurate over a one to thirty flow range. Transition from measurement by the small to the large meter is gradual and there is no sharp cut-over point.

Any of the Sparling indicating and recording instruments may be operated from this Compound Meter by flexible cable of electric connection.

Write for descriptive literature of this and other Sparling Main-line Measuring Equipment.

P. W. SPARLING

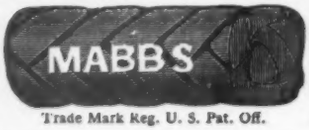
WATER MEASURING EQUIPMENT

LOS ANGELES 945 N. Main St. | CHICAGO 3104 S. Michigan Ave. | CINCINNATI 622 Broadway | NEW YORK 101 Park Ave.

Prevent wear and cutting of rods, plungers, shafts and valve stems by using

MABBS RAWHIDE PACKING

In Your Water Works and Sewage Plants



Trade Mark Reg. U. S. Pat. Off.

IT LASTS LONGER—*Is Anti-Frictional, Saves Power, Labor, and Repairs. Will prove the cheapest packing that can be bought.*

MABBS HYDRAULIC PACKING CO.
Incorporated 1892
431 S. Dearborn St. Chicago, Illinois, U. S. A.

Arrowhead Grating & Tread

Engineers' Handbook sent on request

ARROWHEAD IRON WORKS, Inc.
431 W. 5th St., Kansas City, Mo.

EDSON'S NEW HAND PUMP

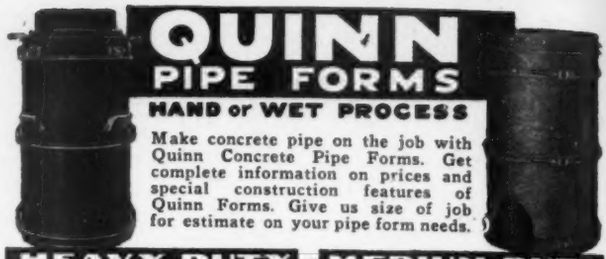
Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

THE EDSON CORP'N, 49 "D" Street
So. Boston, Mass.

NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 1064 Peoples Gas Building

Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

---



QUINN PIPE FORMS

HAND or WET PROCESS

Make concrete pipe on the job with Quinn Concrete Pipe Forms. Get complete information on prices and special construction features of Quinn Forms. Give us size of job for estimate on your pipe form needs.

HEAVY DUTY

Built for more years of service—sizes for any diameter pipe from 12 to 84 inches—any length — tongue and groove or bell end.

MEDIUM DUTY

Makes same sizes pipe as "Heavy Duty" but built to meet demand for lower cost equipment to produce uniform quality in similar amounts.

Also manufacturers of concrete pipe machines for making pipe by machine process.

QUINN WIRE & IRON WORKS 1633 12 St. Boone, Iowa

TAKE THE **BANG** OUT OF MANHOLE COVERS with

TAPAX

Put TAPAX—sticky side down — on flange. Replace cover.

Quick - Easy - Lasting - Economical

WRITE FOR THE STORY OF TAPAX AND TRIAL OFFER

TROHN'S SUPPLIES, Inc.
207 HOYT AVENUE MAMARONECK, N. Y.

NEW ORLEANS' Finest!

We could tell you of the livable rooms, excellent banquet and private party service and facilities, or a host of other fine features of the Jung Hotel, but we prefer to simply say "Choose the Jung as Your New Orleans Stopping Spot and Be Contented."

ROBERTS FILTERS

"STANDARD OF QUALITY"

For more than thirty years we have specialized in the art of water purification. We manufacture a full line of water filters, both pressure and gravity type; Zeolite water softeners; swimming pool recirculating equipment; and various forms of water rectification units. Inquiries are invited on all problems of water treatment.

ROBERTS FILTER MANUFACTURING CO.
607 COLUMBIA AVE. DARBY, PA.

Do your
WATER METERS FREEZE?

The FORD METER MITTEN provides effective insulation for basement water meters and prevents a large majority of frozen meters.

WRITE FOR INFORMATION.

FORD METER BOX CO.
WABASH, INDIANA, U. S. A.

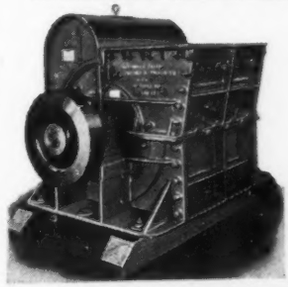
THE
NATIONAL
METHOD OF
WATER MAIN CLEANING

30 YEARS EXPERIENCE

WRITE FOR OUR BOOKLET

NATIONAL WATER MAIN CLEANING CO.
50 CHURCH ST. NEW YORK

GRUENDLER—ESTABLISHED 1885



SHREDDERS
For disposal of
GARBAGE
Sewage—Sludge Screenings

Built in capacities to meet any requirement. Ball Bearing Equipped — Trouble Free — Uniform Reduction.

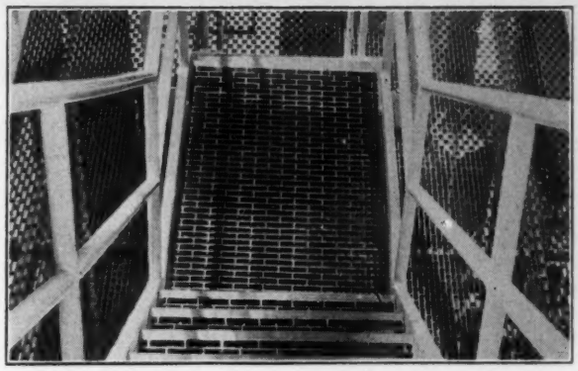
Write for Information

GRUENDLER SHREDDER Installed by City of Atlanta, Ga.

GRUENDLER

GRUENDLER CRUSHER & PULVERIZER CO.
2920-28 NORTH MARKET STREET ST. LOUIS, MO.

OPEN STEEL FLOORING

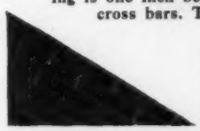


REVERSIBLE RECTANGULAR

KLEMCO GRATING is made in a wide variety of metals to meet most any requirement.

Staggered cross bars provide a non-slip walking surface. The foot contacts two carrier bars and two cross bars at every step. All bars being the same depth and thickness provide increased strength and the same non-slip walking surface on either side.

Made in any desired width, depth, or length. Standard clear opening is one inch between carrier bars and four inches between cross bars. The spacing can be varied as desired.



Descriptive matter and samples of Klemco or Klemp Diamond Grating furnished on request. Our Engineering service available to help solve any ventilated type flooring problem.

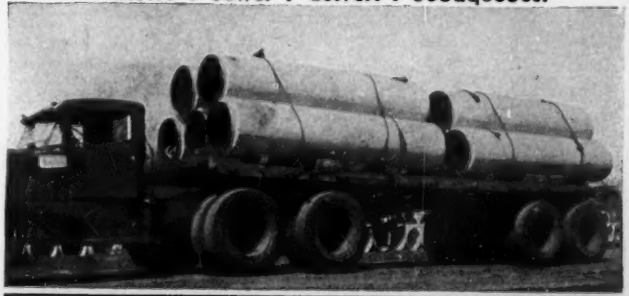
Wm. F. Klemp Company
6640 S. Melvina Avenue Chicago, Ill.

Use P F T Equipment in Your Sewage Treatment Plant

Write for Latest Bulletins

PACIFIC FLUSH TANK COMPANY
Designers & Manufacturers of Sewerage and Sewage Treatment Equipment
4241 Ravenswood Ave. Chicago, Ill.
EXCLUSIVELY SINCE 1893
441 Lexington Ave. New York, N. Y.

Pressure : Sewer : Culvert : Subaqueous.



LOCK JOINT REINFORCED CONCRETE PIPE
LOCK JOINT PIPE CO. Est. 1905. Ampere, N. J.

CHEMICAL FEEDERS

CHLOR-O-FEEDER'S

winter quarters need

hardly be more

elaborate than a

DOG HOUSE

Winter is "just around the corner." The fact that Chlor-O-Feeders are not so subject to winter griefs (hence require no expensive housing!) is important when considering the *total cost* of *buying, installing,* and *maintaining a Chlorinator.*

During the past five winters Chlor-O-Feeders, housed in unheated pits, have kept operating just as long as water continued to flow through the main pipe lines.

The "Little Red Pumps"—feeding one, two, three, or more chemicals—have won hundreds of friends. Bulletin "RED" helps to show why! Write for your copy.

PROPORTIONEERS Inc.

Associated with Builders Iron Foundry

9 N. Codding Street

PROVIDENCE, R. I.

ADVERTISERS

The Dash (—) Denotes Current Advertisers Who Do Not Appear in This Issue

A

A-B-C Mfg. Co. —
Activated Alum Corp. —
Albright & Friel, Inc. 1002
Alvord, Burdick & Howson 1002
American Brass Company 995
American Cast Iron Pipe Co. —
American Colloid Co. —
American Hammered Piston Ring Div. of Koppers Co. 980-981
*American Rolling Mill Co. —
American Water Softener Co. —
American Well Works —
*Armco Culvert Mfgrs. Assn 930
Arrowhead Iron Works 1004
Atlas Mineral Products Co. of Pa. —

B

*Bailey Meter Co. 997
Bartlett Hayward Div. of Koppers Co. 980-981
Bates Co., Inc., Walter —
Black & Veatch 1002
Boston Tow Boat Co. 980-981
Brainard & Co., F. S. —
*Builders Iron Foundry 998
Burns & McDonnell Engr. Co. 1002

C

*Carborundum Co. 979
Cast Iron Pipe Research Assoc., The 970
Chain Belt Co. —
Champion Corp. —
Chester Engrs., The 1002
*Chicago Bridge & Iron Co. 929
*Chicago Pump Co. —
Coleman, Allan J. —
*Columbia Alkali Corp., The —
Columbian Iron Works 969
Corning Glass Works —
Corrugated Steel Sheet Piling Corp. —
Crane Co. 931

D

Darco Corp. 932
Dorr Company, The Third Cover
Dracco Corp. —
*Dresser Mfg. Co., S. R. —

E

Eastern Gas & Fuel Asso. 980-981
Edson Corporation, The 1004
Electro Bleaching Gas Co. 935
Engineering & Construction Div. of Koppers Co. 980-981
Everson Mfg. Co. 1001

F

*Faesy & Besthoff, Inc. 996
Farnan Brass Works Co. —
*Filtration Equipment Corp. —
Ford Meter Box Co. 1005
Fuller & McClintock 1002
Fuller Company —

G

Gas & Coke Div. of Koppers Co. 980-981
Gascoigne & Associates 1002
*General Paint Corp. 1000
*Golden Anderson Valve Spec. Co. —
Greeley & Hansen 1002
Gruendler Crusher & Pulverizer Co. 1005

H

*Hellige, Inc. —
Hill Associates, Nicholas S. 1002
*Hill, Hubbell & Co. 1000
*Hudson Coal Co. —
Hydrauger Corp., Ltd —

I

*Industrial Chemical Sales 967
*Inertol Company, Inc. —
*International Filter Co. 1002

J

*Johns-Manville 933

K

Klemp Co., Wm. F. 1005
Knowles, Inc., Morris 1003
Koppers Coal Co. 980-981
Koppers Company 980-981
Koppers Rheolaveur Co. 980-981

L

Lakeside Engr. Co. —
Layne & Bowler, Inc. —
Leadite Co. —
Link Belt Co. —
Lock Joint Pipe Co. 1005
Ludlow Valve Mfg. Co. 927
Lynchburg Foundry Company —

M

M & H Valve & Fittings Co. —
Mabbs Hydraulic Packing Co. 1004
Maryland Drydock Co. 980-981
*Mathieson Alkali Works, Inc., The 982
Merrimac Division 999
Metcalf & Eddy 1003
Modern Iron Works —
Monsanto Chemical Company 999
Mueller Co. 969
Municipal Service Co. —
Mystic Iron Works 980-981
Mystic Steamship Co. 980-981

N

National Water Main Cleaning Co. 1005
Neptune Meter Co. 940
New England Coal & Coke Co. 980-981
Newsom, Reeves 1003
Nichols Engineering & Research Corp. 938
Northern Gravel Co. —
Nussbaumer & Clarke, Inc. 1003

O

*Oliver United Filters, Inc. —
*Omega Machine Co. —

P

Pacific Flush Tank Co. 1005
*Pennsylvania Salt Mfg. Co. 928
Permutit Company —
*Philadelphia Quartz Co. 1002
Pirnie, Malcolm 1003
*Pittsburgh-Des Moines Steel Co. 937
Pittsburgh-Equitable Meter Co. Front Cover
Pomona Pump Co. —
Potter, Alexander 1003
Portland Cement Assn. —
Powell, Sheppard T. 1003
*Proportioneers, Inc. 1006

Q

Quinn Wire & Iron Works 1004

R

Reilly Tar & Chemical Corp. 968
Rensselaer Valve Co. —
Riddick, Thomas M. 1003
Roberts Filter Mfg. Co. 1005
Ross Valve Mfg. Co., Inc. —
Royer Foundry & Machine Co. —
Russell & Axon 1003

S

Salomon & Bro., L. A. —
Sauereisen Cements Co. —
*Simplex Valve & Meter Co. 936
Smith Co., S. Morgan —
Solvay Sales Corp. —
South Bend Foundry Co. —
*Sparling, R. W. 1004
Syntron Company —

T

Tar & Chemical Div. of Koppers Co. 980-981
Test Plug Mfg. Co. —
Thomson Meter Company 940
Trohn's Supplies, Inc. 1004

U

*United States Pipe & Foundry Co. Second Cover

V

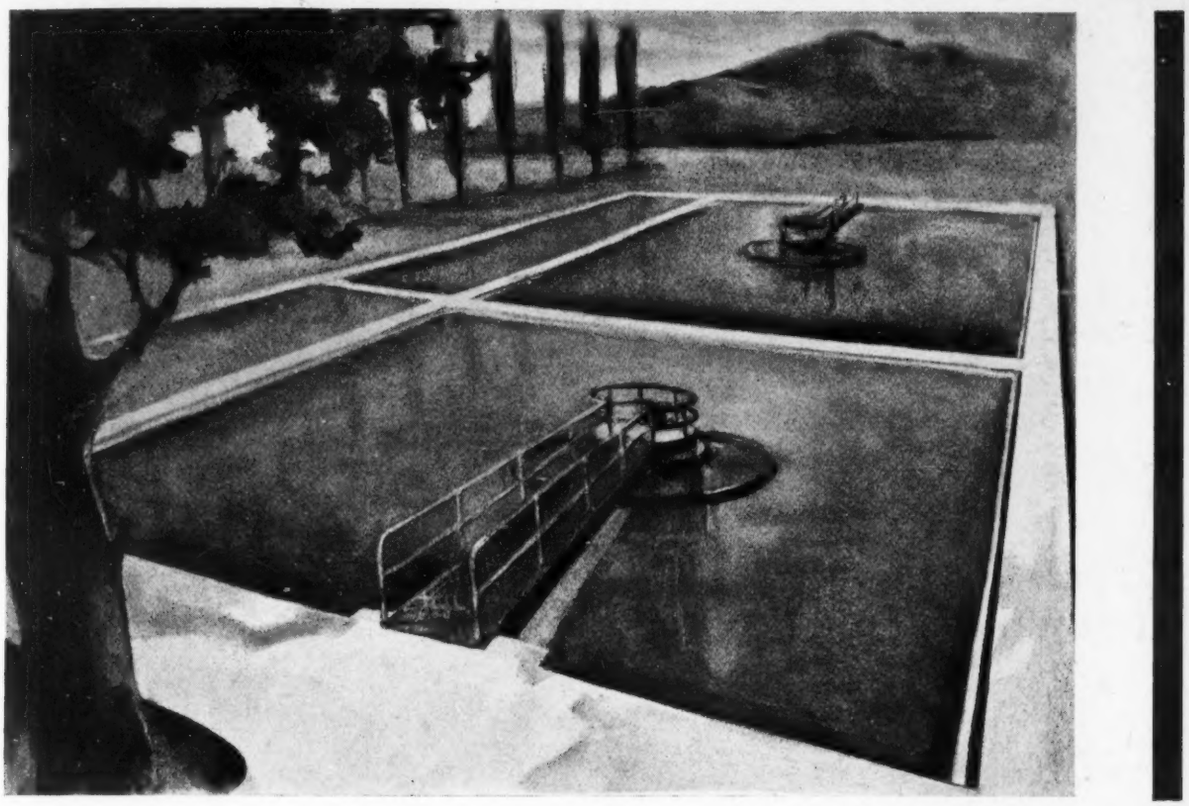
Vogt Mfg. Co., Inc. —

W

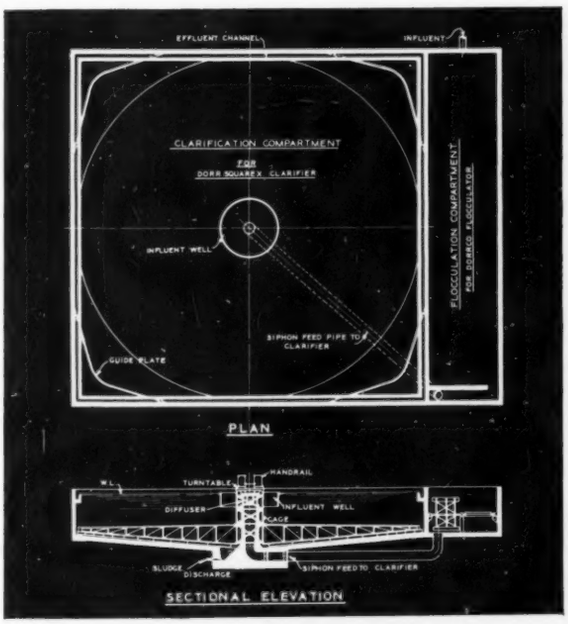
*Wallace & Tiernan Co., Inc. Back Cover
Water Leak Detector Co. —
Western Gas Div. of Koppers Co. 980-981
Westinghouse Elec. & Mfg. Co. —
Weston, L. A. —
Weston and Sampson 1003
White Tar Co. of N. J., The 980-981
Whitman & Howard 1003
Whitman, Requardt and Smith 1003
*Wiley & Sons, Inc., John —
Wilkens-Anderson Co. —
Wood Preserving Corp. 980-981
Wood Co., R. D. 934
Worthington Pump & Mach. Corp. —

*Advertisers with * were represented in the April, 1938, Convention and Data Edition with catalog specification copy. Please refer to that issue for additional information on any of their products.

Announcing THE DORR SQUAREX CLARIFIER



for SINGLE TANK INSTALLATION *with* DORRCO FLOCCULATORS



THE new DORR Squarex Clarifier in combination with Dorrco Flocculators is the ideal Preflocculation and Sedimentation system for sewage, water and trade wastes. A single tank accommodates both units and is ideally adapted to common wall construction for multiple installations.

The distinctive feature of the new "Squarex" clarifier mechanism is a center pier, center drive mechanism that sweeps the entire bottom, including the corners. Feed enters centrally through an inverted siphon and overflow is collected peripherally by a continuous weir.

A Dorr engineer will gladly explain the mechanical details of this compact Flocculator-Clarifier System. How it can effect savings at your plant through proper Preflocculation of feed ahead of Presedimentation.

Unit installation of Dorrco Flocculators and a Dorr Squarex Clarifier in a single tank.

DORRCO

THE DORR COMPANY INC.

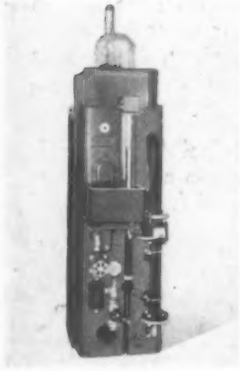
ENGINEERS • 570 Lexington Ave., New York

ATLANTA • TORONTO • CHICAGO • DENVER • LOS ANGELES

DORR TECHNICAL SERVICES AND EQUIPMENT ARE ALSO AVAILABLE FROM THE FOLLOWING COMPANIES:

NETHERLANDS: Dorr-Oliver N.V., The Hague • ENGLAND: Dorr-Oliver Company Ltd., London • GERMANY: Dorr Gesellschaft, m.b.H. Berlin • FRANCE: Soc. Dorr-Oliver, Paris
ITALY: S.A.I. Dorr-Oliver, Milan • JAPAN: Sanki Eng. Co., Ltd., Tokyo • SCANDINAVIA: A.B. Hedemora, Hedemora, Sweden • AUSTRALIA: Crossle & Duff Pty. Ltd., Melbourne
ARGENTINA: Luis Fiore, Buenos Aires • SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg • BRAZIL: Oscar Taves & Co., Rio de Janeiro

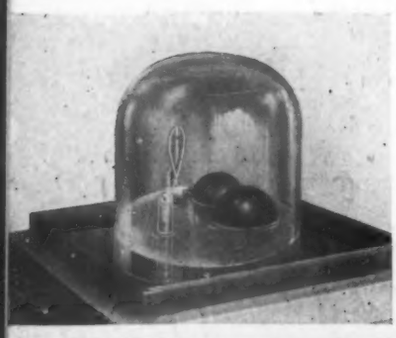
But *Periscopes* aren't practical . . .
. . . *in Chlorination*



SEEING around corners and doing things the hard way is fun for kids but it isn't very practical in anything as important as chlorinator operation.

You don't need mirrors, periscopes or any other optical gadgets to see all the working parts of a W&T Visible Vacuum Chlorinator. They're all housed under the glass bell jar in plain sight. Injector suction, make-up water flow, chlorine pressure regulation, chlorine feed—it's all right there before your eyes. So there isn't much chance of anything going wrong without advance warning in some small operating irregularity. A moment's work in making the necessary adjustment often forestalls an expensive repair job—even more important, causes no serious interruption to continued chlorinator operation.

That is why W&T Visible Vacuum Chlorinators have made and continue to make operating records unchallenged by any other type of chlorine control apparatus.



Write today for technical publications 183-4-5-6-7-8, describing W&T Visible Vacuum Chlorinators, available in arrangements and capacities for any size or type of installation.

"The Only Safe Water is a Sterilized Water"

WALLACE & TIERNAN CO., Inc.

Manufacturers of Chlorine and Ammonia Control Apparatus

NEWARK, NEW JERSEY
Branches in Principal Cities

SA 84